ENERGY AUDIT AT
KWA THYCATTUSSERY WATER TREATMENT & PUMPING STATION

Energy Audit Report

Year: 2020-21

Energy Management Centre – Kerala
Dept of Power, Govt of Kerala.State Designated Agency
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ENERGY AUDIT REPORT

KERALA WATER AUTHORITY TREATMENT PLANT

THYCATTUSSERY

Energy Audit Report

KERALA WATER AUTHORITY TREATMENT PLANT-THYCATTUSSERY

Report No: EA 585

2020-October

Energy Audit Team:

Suresh Babu B V, Accredited Energy Auditor, AEA 33
B. Zachariah, Chief Technical Consultant
Abin Baby, Project Engineer
Mahesh Ramachandran E, Project Engineer
Mohammed Aneez, Project Engineer

Accredited Energy Auditor, AEA 33
Bureau of Energy Efficiency
Government of India

Empaneled Energy Auditor, EMCEEA-0211F,
Energy Management Centre
Government of Kerala.

Acknowledgment

We were privileged to work together with the administration and staff of Kerala Water Authority treatment plant, Thycattussery for their timely help extended to complete the study and bringing out this report on Energy Audit.

We are happy to acknowledge the help extended by Sri. Sojan Jacob Assistant Executive Engineer for their quality interactions and advices to make this audit complete.

We thank our consultants, engineers and backup staff for their dedication to bring this report.

Thank you.

B V Suresh Babu
Accredited Energy Auditor
AEA 33, Bureau of Energy Efficiency
For OTTOTRACTIONS

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Certification

This is to certify that

The data collection has been carried out diligently and truthfully;

All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorised and no tampering of such devices has occurred;

All reasonable professional skill, care and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts;

Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

The energy audit has been carried out in accordance with the Bureau of Energy Efficiency (Manner and Intervals of Time for the Conduct of Energy Audit) Regulations, 2010.

SURESH BABU B V
ACCREDITED ENERGY AUDITOR (AEA 33)

OTTOTRACTIONS- ENERGY AUDIT						
Executive Summary						
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects						
KWA WTP- THYCATTUSSERY						
Sl No	Projects	Investment	Cost saving	SPB	Energy saved	
		(Lakhs Rs)	(Rs)/Yr	Months	kWh/Yr	toE/Yr
1	Energy Saving in Lighting by replacing existing 337 No's T8 Lamps to 18W LED Tube	1.18	1.35	10.52	38822	3.34
2	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (301)	9.19	11.44	9.65	163374	14.05
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (101)	9.16	6.25	17.58	89352	7.68
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (201)	9.62	15.02	7.69	214620	18.46
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (501)	33.52	15.94	25.23	227760	19.59
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (601)	28.78	27.84	12.41	397704	34.20
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (701)	30.47	37.96	9.63	542244	46.63
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (801)	35.30	26.49	15.99	378432	32.55
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (901)	1.94	2.27	13.59	32412	176
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1001)	2.28	2.21	13.97	31536	350
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1101)	32.69	8.40	14.51	120012	685
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1201)	35.89	16.13	14.13	230388	1363
13	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1301)	30.38	26.49	14.93	378432	2707
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1401)	34.10	20.91	13.64	298716	5395
15	Energy Saving in Lighting by replacing existing 36 No's 250W Sodium vapour Lamps to 150W LED.	0.92	0.65	13.80	10368	10756
16	Energy Saving by arresting leakages in flanges and other joints of the line.					
17	Improve the power factor to unity will save energy cost by getting PF incentives.					
18	Installation of Solar Power Plant (50kWe) on the rooftop and other vacant area to cater lighting loads.	37.5	3.83	117	63875	5.49
Total		332.92	223.18	20.27	3218047.40	21613.98

1

Introduction

A detailed energy audit has been carried out at **KERALA WATER AUTHORITY WATER TREATMENT PLANT AND PUMPING STATION, THYCATTUSSERY** in September 2020. **Energy Management Centre – Kerala (EMC) has entrusted** OTTOTRACTIONS an Accredited Energy Auditor of Bureau of Energy Efficiency and Empaneled Energy Auditor of Energy Management Centre, Government of Kerala to conduct this audit for EMC. The energy audit has identified energy conservation opportunities and recommended projects to improve energy efficiency of the facility.

About EMC-Kerala

Kerala Government has become the first State Government in India to establish an **Energy Management Centre (EMC)** at State level, aiming primarily to remould and instrumentalise energy sector as a catalyst in promoting a development process which is econo-ecologically sustainable. With a view to making energy sector achieve such a lead and catalytic role, EMC has evolved a novel and comprehensive energy management approach and institutional philosophy encompassing management of energy technology systems - both conventional and non-conventional, energy conservation in all sectors of the economy, energy resource management, rural and urban energy systems, energy education and training, energy generation and conservation based employment and poverty alleviation programmes.

India, one of the most affected countries in terms of energy shortage and increasing energy price became one such country in the world to adopt energy management measures at the earliest in all sectors of the economy on a priority basis, including popularising and promoting renewable energy technology and resources.

When liberalization and globalization of economy take effect, energy management aimed at enhancing total energy efficiency in all sectors of the economy becomes a major factor in determining the comprehensive competitiveness of the economy.

Giving due consideration to this energy-economy interaction process/scenario, the Government of Kerala took leadership initiatives for establishing a multi-disciplinary Energy Management Centre under the Department of Power.

This energy audit report complies with the clauses in *Energy Conservation Act, 2001* on mandatory energy audit (**Form 4** [refer regulation 6(2)] guidelines for preparation of energy audit report) and complies with the G.O (Rt) No.2/2011/PD dated 01.01.2011 issued by Government of Kerala on mandatory energy audit.

1.1. General plant/establishment details and descriptions

Kerala water authority was established in first April 1984 under Kerala water and waste water ordinance. The Thycattussery PH Head works subdivision with consumer numbers 7/5814 (1355140011241). It has an installed capacity of 107 MLD (million liters per day) with 365 days working. The plant is working at 50% capacity utilisation now.

Base line Data (Electrical System)

Code	EA 585
Facility	KERALA WATER AUTHORITY, THYCATTUSSERY
Provider	KSEB Ltd
Consumer No	1355140011241
Contract Demand (kVA)	1374
Tariff	HT1(A) Industrial
Energy Charge Rs/ kWh Z1	5.5
Energy Charge Rs/ kWh Z2	8.25
Energy Charge Rs/ kWh Z3	4.125
Demand Charge Rs/ kVA	300
Excess Demand Rs/kVA	150
Energy Bill Analysis interval	2018-19

1.2. Energy audit team

The Energy Audit team is listed below. Besides this list various domine experts also participated in this project.

1. Suresh Babu B V, Accredited Energy Auditor, AEA 33
2. B. Zachariah, Chief Technical Consultant
3. Abhijith M R, Certified Energy Auditor
4. Abin Baby, Project Engineer
5. Mahesh Ramachandran E, Project Engineer
6. Mohammed Aneez, Project Engineer

1.3. Component of production cost

1. Energy (Electricity)
2. Manpower (Permanent & Contract)
3. Consumables
4. Overhead & others

1.4. Major energy use areas

Electricity from KSEB 100% holds the share in the total energy consumed in this facility.

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Production process description

The intake works and raw water pumping station of thycattussery water treatment plant is located on Muvattupuzha River at piravom. The raw water main for total length 22km is laid for transferring raw water from river intake pumping station at piravom. Two break pressure tanks are provided for providing residual head for conveying raw water to water treatment plant. The treated water pumping station have 4 Zones Zone 1, Zone 2A, Zone 2A and Zone 3.

- **Zone 1**

  Zone 1 having 3 pumps (2 working + 1 standby) the motors are 55kW each. The installed capacity of Zone 1 is **10.8 MLD**

- **Zone 2A**

  Zone 2A having 5 pumps (3 working + 2 standby) the motors are 180kW each. The installed capacity of Zone 2A is **48.5 MLD**

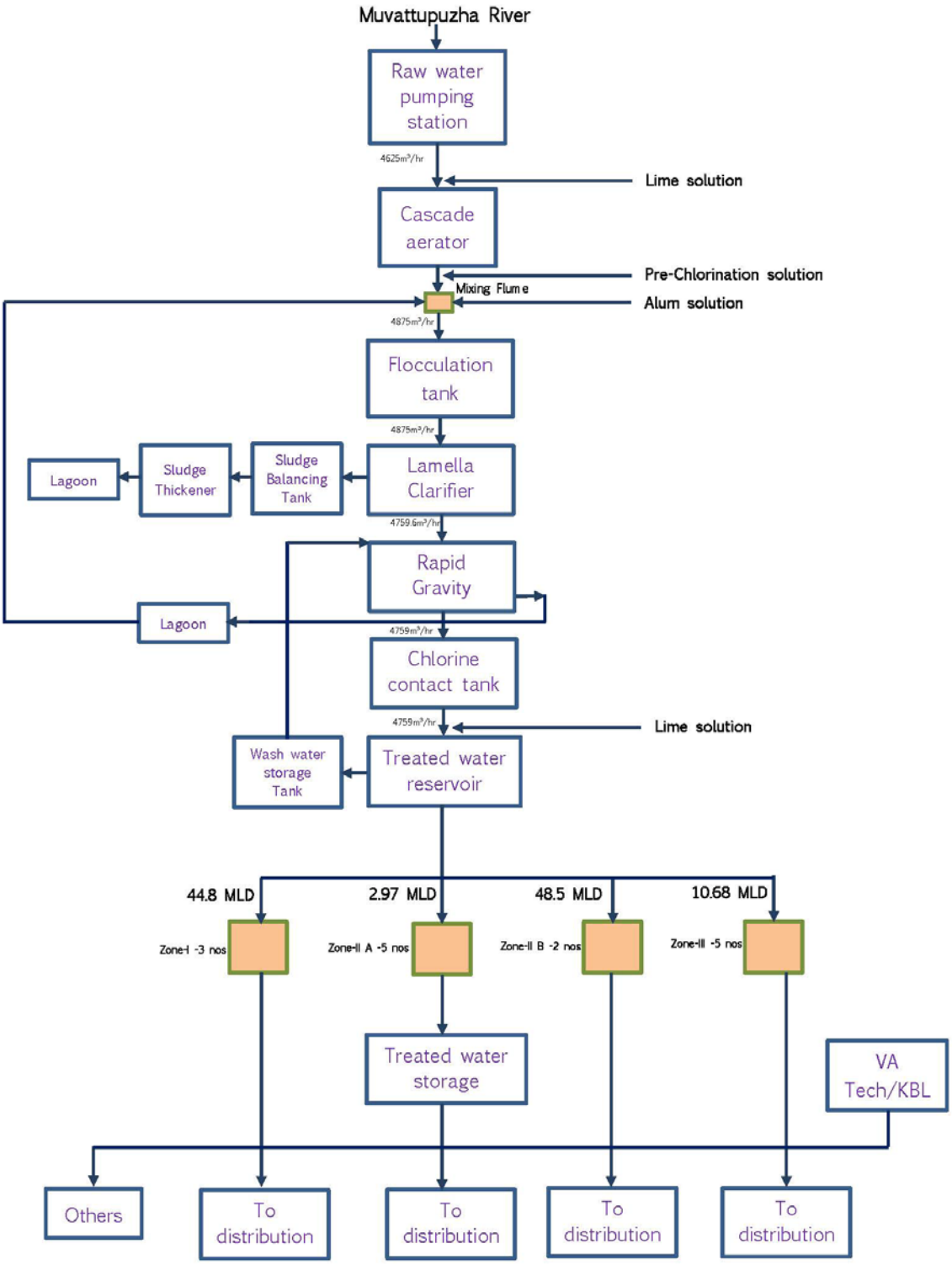
- **Zone 2B**

  Zone 2B having 2 pumps (1 working + 1 standby) the motors are 15kW each. The installed capacity of Zone 2B is **3 MLD**

- **Zone 3**

  Zone 3 having 5 pumps (3 working + 2 standby) the motors are 180kW each. The installed capacity of Zone 2B is **44.8 MLD**

  The detailed flow process diagram is showing below.


Muvattupuzha River
Raw water pumping station
4625m³/hr
Lime solution
Cascade aerator
Pre-Chlorination solution
Mixing Flume
Alum solution
4875m³/hr
Flocculation tank
4875m³/hr
Lagoon
Sludge Thickener
Sludge Balancing Tank
Lamella Clarifier
4759.6m³/hr
Rapid Gravity
Lagoon
4759m³/hr
Chlorine contact tank
4759m³/hr
Lime solution
Wash water storage Tank
Treated water reservoir
44.8 MLD
2.97 MLD
48.5 MLD
10.68 MLD
Zone-I -3 nos
Zone-II A -5 nos
Zone-II B -2 nos
Zone-III -5 nos
Treated water storage
VA Tech/KBL
Others
To distribution
To distribution
To distribution
To distribution

3

Energy and utility system description

3.1. List of utilities

Electricity is only fuel used in the facility.

3.2 Brief description of each utility

3.2.1 Electricity

The facility is a consumer of Kerala State Electricity Board (KSEB) under HT – I (A) Industrial Tariff category at 11 kV. The facility having two HT connections with contract demand of 1850 kVA. The details of transformer installed in the facility are given below.

Details of Transformers				
Sl.No	Make	Year of manufacturing	Rating (kVA)	Voltage (V)
1	INDO Tech	2009	1600	440
2	INDO Tech	2009	1600	440
3	INDO Tech	2009	600	440
4	INDO Tech	2009	600	440

The power factor is being maintained as 0.93. The electrical load study and power quality analysis has been conducted and the results and reports are given in the "Technical Supplement" of this report.

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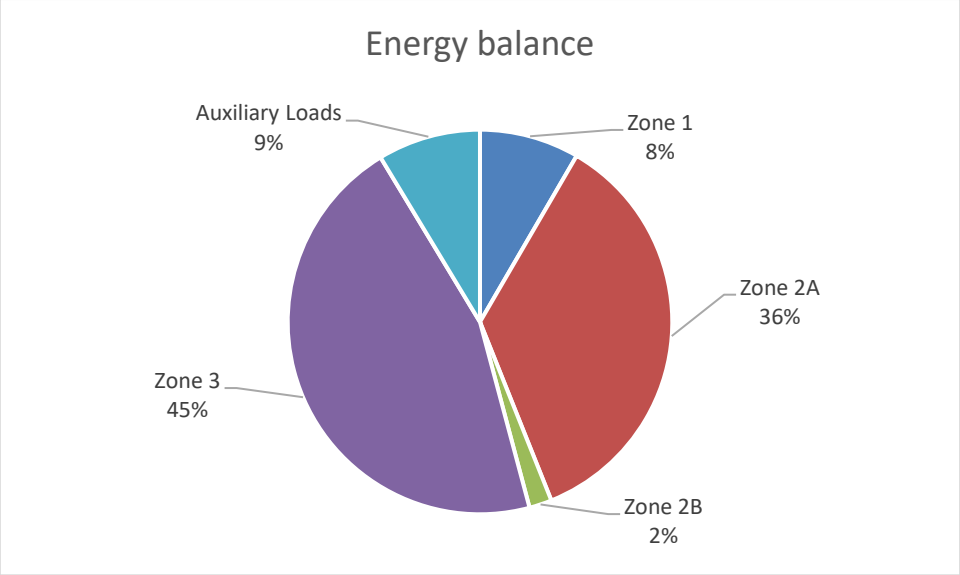
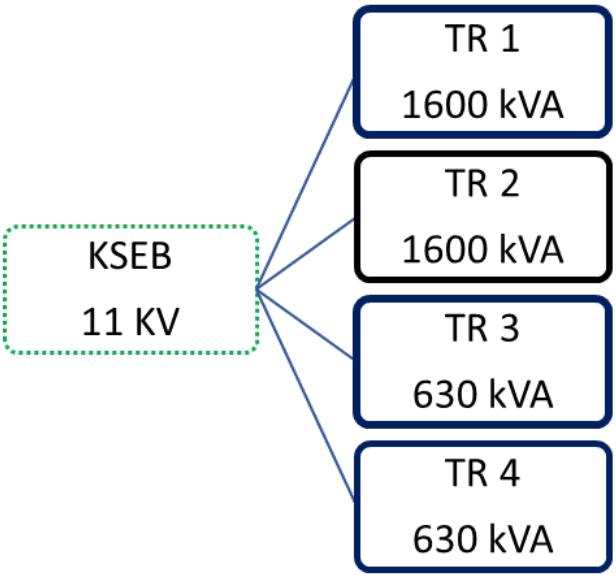
Detailed process flow diagram and energy and material balance

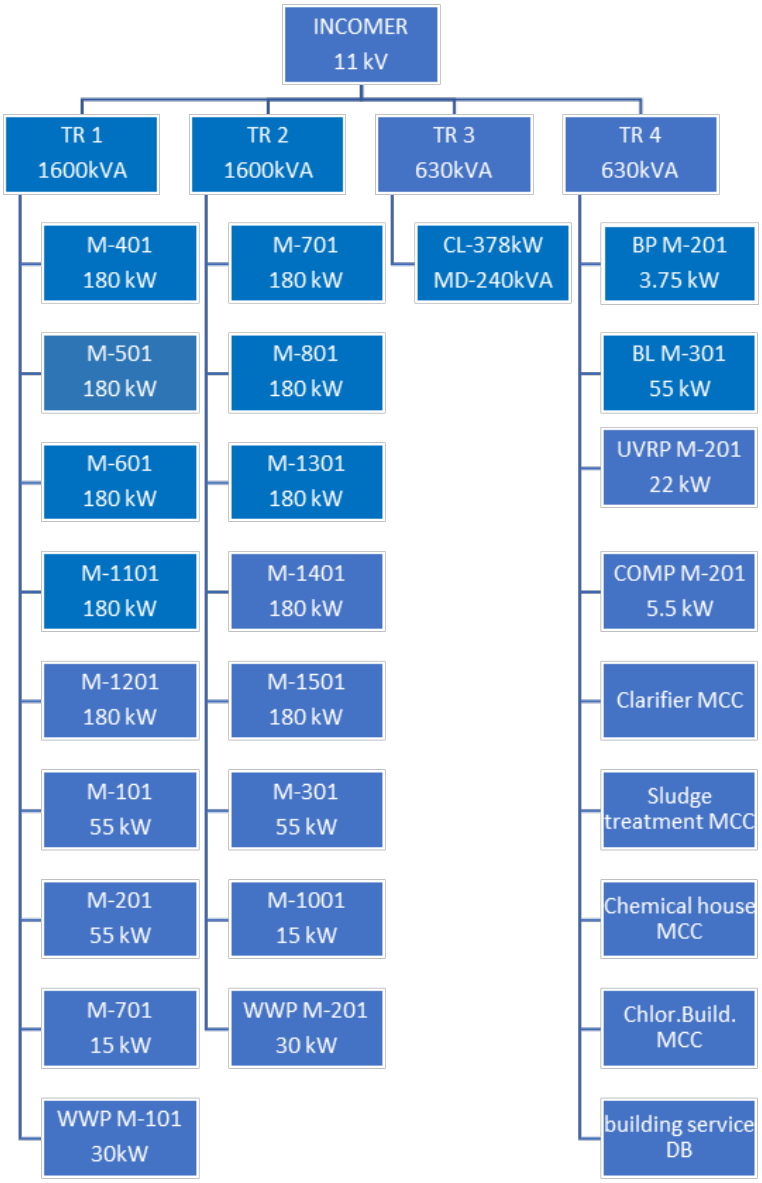


The energy balance of this facility is given above. The auxiliary loads caters 9% of the total load

Plant Operation

The water treatment plant has 4 transformers, out of 4, 2 numbers are 1600kVA, 11kV/3.3kV HT transformers and 2 numbers are 500kVA 11kV / 440 V LT transformers. The detailed SLD of substations and process are given in this section.




INCOMER
11 kV
TR 1
1600kVA
TR 2
1600kVA
TR 3
630kVA
TR 4
630kVA
M-401
180 kW
M-501
180 kW
M-601
180 kW
M-1101
180 kW
M-1201
180 kW
M-101
55 kW
M-201
55 kW
M-701
15 kW
WWP M-101
30kW
M-701
180 kW
M-801
180 kW
M-1301
180 kW
M-1401
180 kW
M-1501
180 kW
M-301
55 kW
M-1001
15 kW
WWP M-201
30 kW
CL-378kW
MD-240kVA
BP M-201
3.75 kW
BL M-301
55 kW
UVRP M-201
22 kW
COMP M-201
5.5 kW
Clarifier MCC
Sludge
treatment MCC
Chemical house
MCC
Chlor.Build.
MCC
building service
DB

5

Performance evaluation of major utilities and process equipment's/systems.

5.1. List of equipment and process where performance testing was done.

- Electrical System
- Pumps
- Lighting System
- Renewable Energy

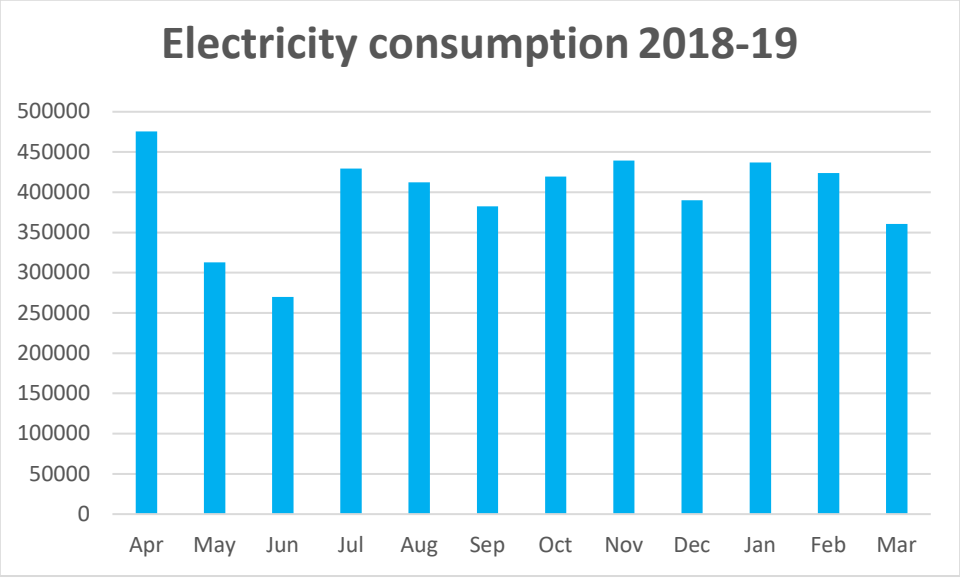
5.2. Results of performance testing

5.2.1. Electrical System

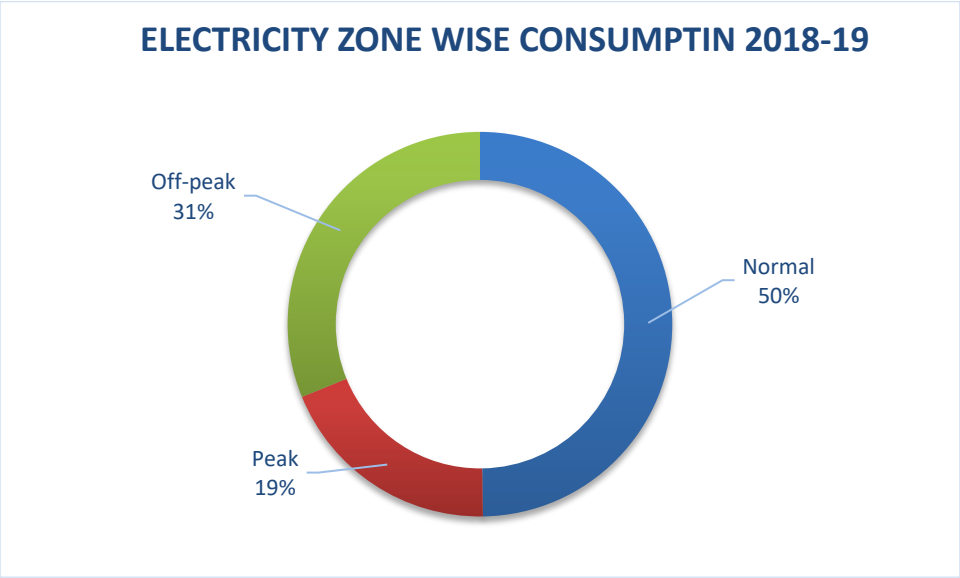
The average unit cost of electricity is **6.83 Rs/kWh**. This is taken as the basis for the financial analysis of electrical energy efficiency projects. The information on average energy consumption is taken from the historical electricity bill analysis. The electricity is fed from centralized substations. The Maximum demand observed during electricity bill analysis was 944 kVA.

Electricity Consumption

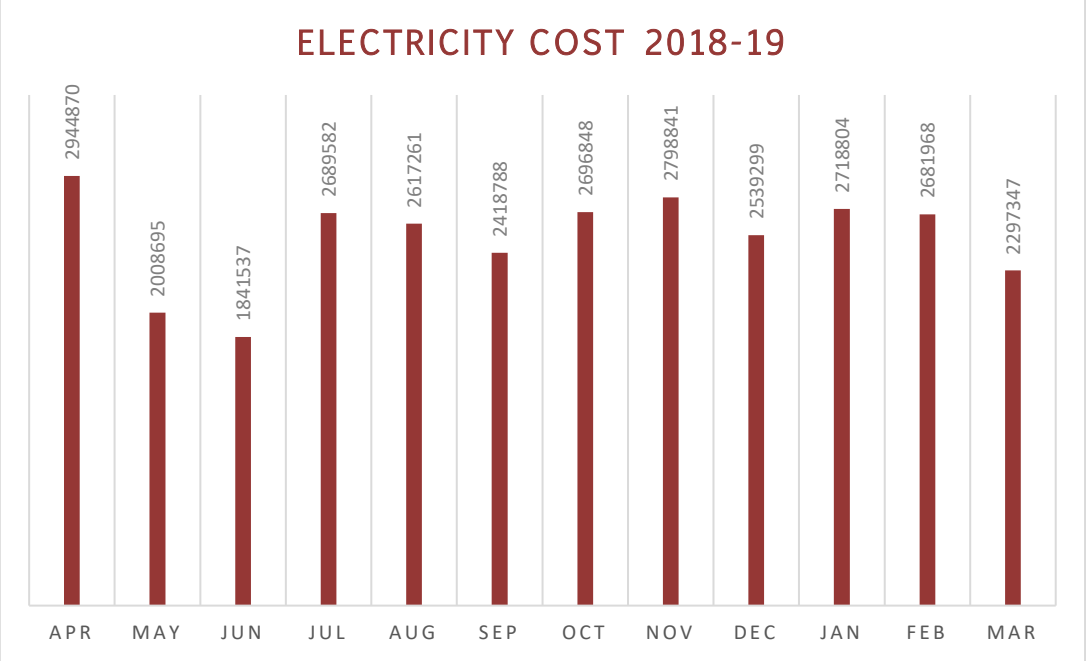
The Electricity consumption details for the financial year 2018-19 is plotted below. The Total consumption was found to be 47.52 Lakhs Units in the year 18-19.



The Zone wise Energy Consumption Profile is shown below ,which shows 48% of total energy consumption in a day is at normal hours, 35% at peak hours and 17% at non peak hours.

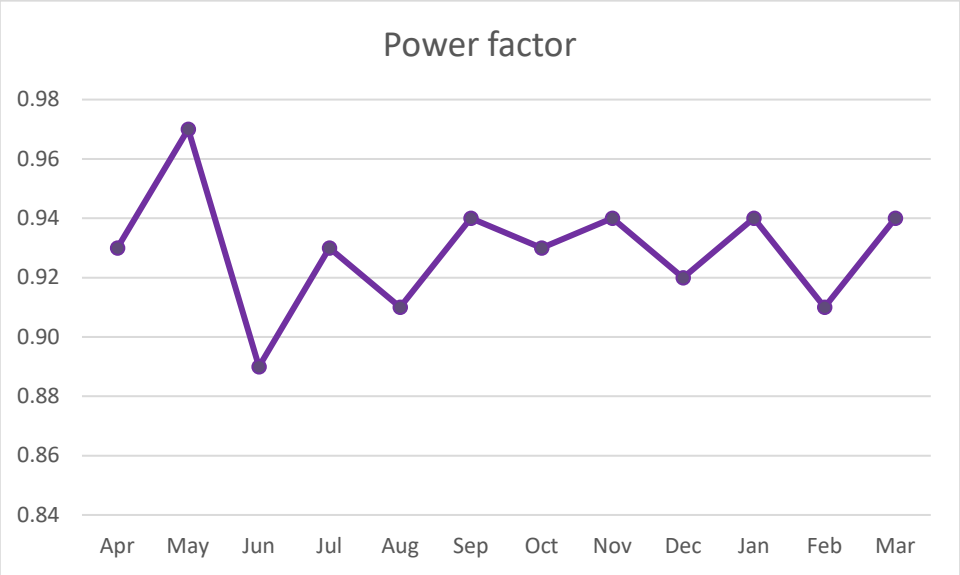


The electricity cost profile for the year 2018-19 is given below. The peak energy consumption can be reduced by curtailing non-essential loads like backwashing and cleaning.



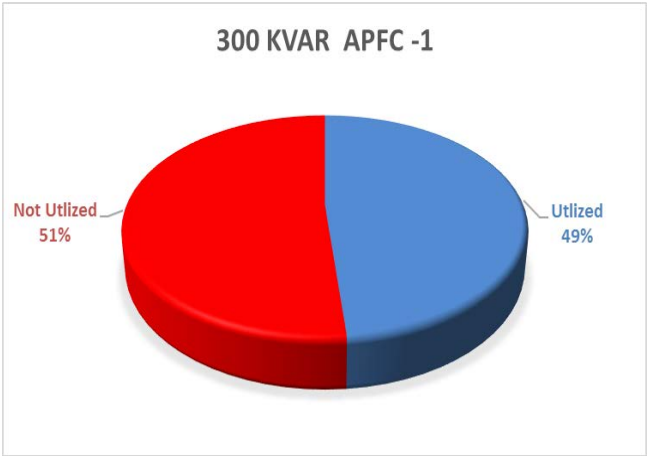
Power Factor

The average power factor observed is 0.93 which is very low. It is strongly recommend to add capacitors to improve power factor to unity. The power factor variation for the financial year 2018-19 is shown below.

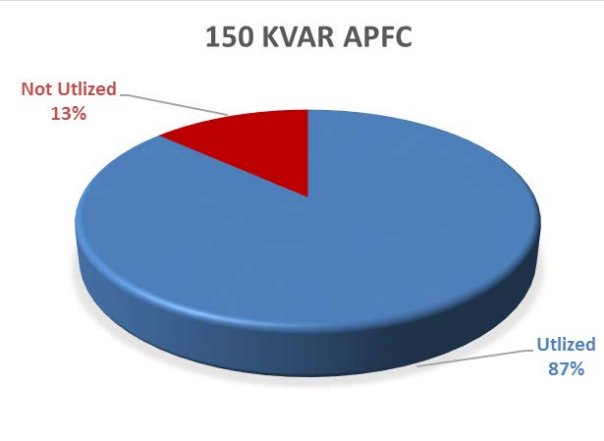


APFC Performance

300 kVAR APFC (Transformer-1) Performance				
Capacitor	R	Y	B	Total
1	0	0	0	0
2	12.46	12.07	12.11	36.64
3	6.24	3.21	3.2	12.65
4	0	0	0	0
5	9.47	9.67	12.87	32.01
6	0	4.86	4.83	9.69
7	2.97	3.07	3.06	9.1
8	0	0	0	0
9	12.62	11.77	12.1	36.49
10	2.96	3.06	3.1	9.12
Total				145.7

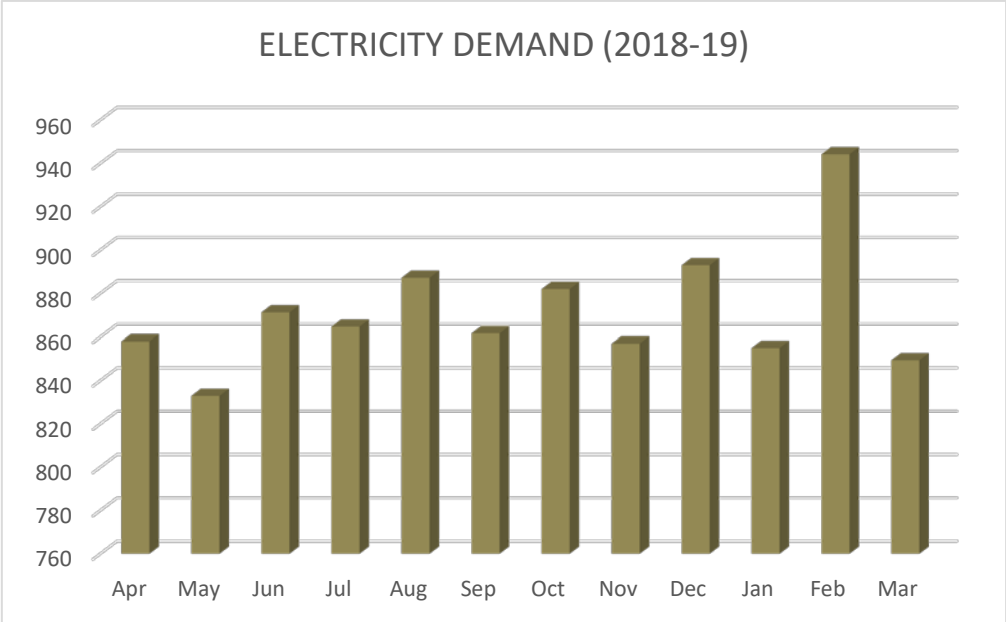


150 kVAR APFC (Transformer-3) Performance				
Capacitor	R	Y	B	Total
1	0	0	0	0
2	2.91	2.79	2.9	8.6
3	2.91	2.78	2.89	8.58
4	7.59	7.26	7.53	22.38
5	7.70	7.36	7.52	22.58
6	7.74	7.38	7.54	22.66
7	7.73	7.38	7.58	22.69
8	7.69	7.32	7.52	22.53
Total				130.02



Demand Control

The facility has a contract demand of 1374kVA. As mentioned above the present average power factor of the plant is 0.93 and the average recorded maximum demand is 944 kVA as per historical energy consumption analysis. The electricity demand variation for the financial year 2018-19 is shown below.



- The demand can be controlled by maintaining unity power factor

5.2.2. Pumps

The list of pumps are given below.

Sl.No	Location		HP	Motor make	Pump make	KW (Rated)	Year of Mfg.	kW (Measured)
1	ZONE 1	Motor No 1	74	Marathon	Kirloskar	55	2008	48.5
2		Motor No 2	74	Marathon	Kirloskar	55	2008	49.1
3		Motor No 3	74	Marathon	Kirloskar	55	2008	54
4	ZONE 2A	Motor No 1	241	Marathon	Kirloskar	180	2008	135
5		Motor No 2	241	Marathon	Kirloskar	180	2008	139
6		Motor No 3	241	Marathon	Kirloskar	180	2008	169
7		Motor No 4	241	Marathon	Kirloskar	180	2008	158
8		Motor No 5	241	Marathon	Kirloskar	180	2008	-
9	ZONE 2B	Motor No 1	20	Marathon	Kirloskar	15	2009	10
10		Motor No 2	20	Marathon	Kirloskar	15	2009	11
11	ZONE 3	Motor No 1	241	Marathon	Kirloskar	180	2009	120
12		Motor No 2	241	Marathon	Kirloskar	180	2009	143
13		Motor No 3	241	Marathon	Kirloskar	180	2009	142
14		Motor No 4	241	Marathon	Kirloskar	180	2009	145
15		Motor No 5	241	Marathon	Kirloskar	180	2009	-
16	Flocculattor	Motor No 1	3	Siemens		2.2		
17		Motor No 2	3	Siemens		2.2		
18		Motor No 3	3	Siemens		2.2		
19		Motor No 4	3	Siemens		2.2		
20		Motor No 5	3	Siemens		2.2		
21		Motor No 6	3	Siemens		2.2		
22		Motor No 7	3	Siemens		2.2		
23		Motor No 8	3	Siemens		2.2		
24		Motor No 9	3	Siemens		2.2		
25		Motor No 10	3	Siemens		2.2		
26		Motor No 11	3	Siemens		2.2		
27		Motor No 12	3	Siemens		2.2		
28		Motor No 13	3	Siemens		2.2		
29		Motor No 14	3	Siemens		2.2		
30		Motor No 15	3	Siemens		2.2		
31		Motor No 16	3	Siemens		2.2		
32	Clarifier	Motor No 1	1	CG		0.75		
33		Motor No 2	1	CG		0.75		
34		Motor No 3	1	CG		0.75		
35		Motor No 4	1	CG		0.75		

36	Other motors	Motor No 1	74	Siemens		55		
37		Motor No 2	74	Siemens		55		
38		Motor No 3	74	Siemens		55		
39		Motor No 4	50	KBL		37		
40		Motor No 5	50	KBL		37		
41		Motor No 6	40	Siemens		30		
42		Motor No 7	40	Siemens		30		
43		Motor No 8	7	Siemens		5.5		
44		Motor No 9	7	Siemens		5.5		
45		Motor No 10	7	Marathon		5.5		
46		Motor No 11	7	Marathon		5.5		
47		Motor No 12	7	Marathon		5.5		
48		Motor No 13	7	Marathon		5.5		
49		Motor No 14	7	Marathon		5.5		
50		Motor No 15	7	Marathon		5.5		
51		Motor No 16	5	NGEF		3.75		
52		Motor No 17	5	NGEF		3.75		
53		Motor No 18	5	Siemens		3.7		
54		Motor No 19	5	Siemens		3.7		
55		Motor No 20	5	Siemens		3.7		
56		Motor No 21	5	Siemens		3.7		
57		Motor No 22	5	CG		3.7		
58		Motor No 23	5	CG		3.7		
59		Motor No 24	5	Siemens		3.7		
60		Motor No 25	5	Siemens		3.7		
61		Motor No 26	5	Siemens		3.7		
62		Motor No 27	5	Siemens		3.7		
63		Motor No 28	5	KBL		3.7		
64		Motor No 29	5	KBL		3.7		
65		Motor No 30	3	Siemens		2.2		
66		Motor No 31	3	Siemens		2.2		
67		Motor No 32	3	CG		2.2		
68		Motor No 33	3	KBL		2.2		
69		Motor No 34	3	KBL		2.2		
70		Motor No 35	2	Siemens		1.5		
71		Motor No 36	2	Siemens		1.5		
72		Motor No 37	2	Siemens		1.5		
73		Motor No 38	2	Siemens		1.5		
74		Motor No 39	2	Siemens		1.5		
75		Motor No 40	2	Siemens		1.5		
76		Motor No 41	2	Flight		1.5		
77		Motor No 42	2	Flight		1.5		
78		Motor No 43	1	CG		0.75		
79		Motor No 44	1	CG		0.75		
80		Motor No 45	0	Siemens		0.37		
81		Motor No 46	0	Siemens		0.37		

Performance Evaluation of Pumps					
Pure Water Pump Zone 1 (301)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	301	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	50
	Motors	6	Rated load of the motor	kW	55
		7	Measured load of the motor	kW	48.55
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	40.00
	Pumps	11	Make		KBL
		12	HP		73
		13	Efficiency	%	80
		14	Combined efficiency of the system (rated)	%	72.00
		15	Combined efficiency of the system (actual)	%	55.51
		16	Volt	V	422
		17	Amps	A	95
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	5.64
		23	Head	m	43
		24	Flow	m^3/s	0.064
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	26.95
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	97.87
		33	% loading of pump on head	%	86.00
		34	% loading of motor	%	88.27

Performance Evaluation of Pumps					
Pure Water Pump Zone 1 (101)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	101	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	50
	Motors	6	Rated load of the motor	kW	55
		7	Measured load of the motor	kW	49.18
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	40.00
	Pumps	11	Make		KBL
		12	HP		73
		13	Efficiency	%	80
		14	Combined efficiency of the system (rated)	%	72.00
		15	Combined efficiency of the system (actual)	%	54.86
		16	Volt	V	420
		17	Amps	A	94
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	5.64
		23	Head	m	45
		24	Flow	m^3/s	0.061
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	26.98
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	93.62
		33	% loading of pump on head	%	90.00
		34	% loading of motor	%	89.41

Performance Evaluation of Pumps					
Pure Water Pump Zone 1 (201)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	201	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	50
	Motors	6	Rated load of the motor	kW	55
		7	Measured load of the motor	kW	55.80
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	40.00
	Pumps	11	Make		KBL
		12	HP		73
		13	Efficiency	%	80
		14	Combined efficiency of the system (rated)	%	72.00
		15	Combined efficiency of the system (actual)	%	50.54
		16	Volt	V	420
		17	Amps	A	96
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	5.64
		23	Head	m	45
		24	Flow	m^3/s	0.064
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	28.20
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	97.87
		33	% loading of pump on head	%	90.00
		34	% loading of motor	%	101.46

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 A (501)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	501	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	66
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	135
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	135
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	73.10
		16	Volt	V	420
		17	Amps	A	247
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	14.69
		23	Head	m	59
		24	Flow	m^3/s	0.170
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	98.39
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	89.39
		34	% loading of motor	%	74.78

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 A (601)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	601	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	66
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	139
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	139
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	60.58
		16	Volt	V	420
		17	Amps	A	255
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	13.08
		23	Head	m	57
		24	Flow	m^3/s	0.151
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	84.19
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	99.45
		33	% loading of pump on head	%	86.36
		34	% loading of motor	%	77.20

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 A (701)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	701	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	66
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	161
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	161
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	55.61
		16	Volt	V	420
		17	Amps	A	270
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	13.92
		23	Head	m	57
		24	Flow	m^3/s	0.160
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	89.47
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	99.31
		33	% loading of pump on head	%	86.36
		34	% loading of motor	%	89.37

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 A (801)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	801	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	66.5
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	158
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	158
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	65.78
		16	Volt	V	420
		17	Amps	A	265
		18	rpm	rpm	1480
	Pipe Line	19	Material		GRP
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	15.50
		23	Head	m	59
		24	Flow	m^3/s	0.179
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	103.86
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	88.72
		34	% loading of motor	%	87.72

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 B (901)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	801	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	24
	Motors	6	Rated load of the motor	kW	15
		7	Measured load of the motor	kW	10
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	10
	Pumps	11	Make		KBL
		12	HP		20
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	76.50
		15	Combined efficiency of the system (actual)	%	55.93
		16	Volt	V	415
		17	Amps	A	19
		18	rpm	rpm	1460
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	2.52
		23	Head	m	20
		24	Flow	m^3/s	0.029
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	5.72
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	83.33
		34	% loading of motor	%	68.21

Performance Evaluation of Pumps					
Pure Water Pump Zone 2 B (1001)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	1001	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	24
	Motors	6	Rated load of the motor	kW	15
		7	Measured load of the motor	kW	11
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	11
	Pumps	11	Make		KBL
		12	HP		20
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	76.50
		15	Combined efficiency of the system (actual)	%	61.74
		16	Volt	V	415
		17	Amps	A	20
		18	rpm	rpm	1460
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	2.93
		23	Head	m	20
		24	Flow	m^3/s	0.034
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	6.65
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	25
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	83.33
		34	% loading of motor	%	71.80

Performance Evaluation of Pumps					
Pure Water Pump Zone 3 (1101)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	1101	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	67
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	120
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	120
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	79.68
		16	Volt	V	415
		17	Amps	A	209
		18	rpm	rpm	1484
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	14.04
		23	Head	m	60
		24	Flow	m^3/s	0.163
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	95.65
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	25
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	89.55
		34	% loading of motor	%	66.69

Performance Evaluation of Pumps					
Pure Water Pump Zone 3 (1101)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	1101	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	67
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	143
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	143
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	73.78
		16	Volt	V	415
		17	Amps	A	252
		18	rpm	rpm	1484
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	15.48
		23	Head	m	60
		24	Flow	m^3/s	0.179
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	105.46
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	25
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	89.55
		34	% loading of motor	%	79.41

Performance Evaluation of Pumps					
Pure Water Pump Zone 3 (1301)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	1301	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	67
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	142
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	142
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	62.83
		16	Volt	V	415
		17	Amps	A	250
		18	rpm	rpm	1484
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	12.86
		23	Head	m	61
		24	Flow	m^3/s	0.149
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	89.10
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	25
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	91.04
		34	% loading of motor	%	78.78

Performance Evaluation of Pumps					
Pure Water Pump Zone 3 (1401)					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA THYCATTUSSERY	
		2	Pump ID	1401	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	67
	Motors	6	Rated load of the motor	kW	180
		7	Measured load of the motor	kW	145
		8	Efficiency of standard motor	%	95
		9	Type of Motor		IM
		10	Motor power	kW	145
	Pumps	11	Make		KBL
		12	HP		241
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	80.75
		15	Combined efficiency of the system (actual)	%	69.03
		16	Volt	V	415
		17	Amps	A	255
		18	rpm	rpm	1484
	Pipe Line	19	Material		GRP
		20	Size	mm	900
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	14.90
		23	Head	m	59
		24	Flow	m^3/s	0.173
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	99.84
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	25
		32	% loading of pump on flow	%	100.00
		33	% loading of pump on head	%	88.06
		34	% loading of motor	%	80.35

5.2.3. Lighting system

T12 and T8 tubes are extensively used in most of the areas and Sodium vapor, Fluorescent etc. in factory/ street lighting. Hardly any LED lights or tubes are used. This is a good component of the load of the facility and replacing these T12 & T 8 tubes with LED tubes can lead to a significant reduction in the load. Good lighting design can reduce costs and have the added benefit of decreasing internal heat gains, thus reducing the need for air conditioning too.

All T8 and T12 Lamps shall be replaced with LED tubes or even T5 and the existing CFLs may be shifted to LED in phased manner. Since lighting does not have a separate feeder, the voltage stabilizer cannot be used specifically for this purpose.

Power Quality

Power quality is simply the interaction of electrical power with electrical equipment. If electrical equipment operates correctly and reliably without being damaged or stressed, we would say that the electrical power is of good quality. On the other hand, if the electrical equipment malfunctions, is unreliable, or is damaged during normal usage, we would suspect that the power quality is poor.

In any alternating current network, flow of current depends upon the voltage applied and the impedance (resistance to AC) provided by elements like resistances, reactance's of inductive and capacitive nature. Harmonics occurs as spikes at intervals which are multiples of the mains (supply) frequency and these distort the pure sine wave form of the supply voltage & current. The poor power quality end up with power loss.

Power system harmonic distortion is not a new phenomenon - efforts to limit it to acceptable proportions have been a concern of power engineers from the early days of utility systems. At that time, the distortion was typically caused by the magnetic saturation of transformers or by certain industrial loads, such as arc furnaces or arc welders. The major concerns were the effects of harmonics on synchronous and induction machines, telephone interference, and power capacitor failures. In the past,

harmonic problems could often be tolerated because equipment was of conservative design and grounded wye-delta transformer connections were used judiciously.

Harmonic distortion

Harmonic distortion problems are not new to utility and industrial power systems. In fact, such distortion was observed by utility operating personnel as early as the first decade of this century. Typically, the distortion was caused by nonlinear loads connected to utility distribution systems. In addition to the increase in harmonic generators and network resonances, electric systems and loads have become no less, and in some cases even more, sensitive to harmonics. There are a number of areas of new and continuing concern

- Computers, computer-controlled machine tools, and various types of digital controllers are especially susceptible to harmonics, as well as to other types of interference.
- Harmonics can cause damaging dielectric heating in underground cables.
- Inductive metering can be adversely affected by harmonics.
- Capacitor bank failures are frequently caused by harmonics.
- Less conservative designs for rotating machines and transformers aggravate heating problems caused by harmonics.
- Harmonics can be especially troublesome to communication systems.

POWER QUALITY ANALYSIS REPORT					
KWA Thycattussery					
Location & Code:		Motor 1001 (15kW)			
Date & Time		20-01-2020 12:37 to 20-01-2020 12:38			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	426.00		Normal
		Y	433.00		
		B	432.00		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.73			Low power factor
8	Load Current (Waveform)	distorted			due to winding problem
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	17.80	1.87	Within permissible limit at Average load during load study
		Y	19.80	1.99	
		B	20.40	2.12	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	17.80	5.59	Within permissible limit at Average load during load study
		Y	19.80	5.22	
		B	20.40	5.27	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Thycattussery					
Location & Code:		Motor 1201 (180KkW)			
Date & Time		20-01-2020 12:28 to 20-01-2020 12:29			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	420.00		Normal
		Y	427.00		
		B	426.00		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.76			Low power factor
8	Load Current (Waveform)	distorted			due to winding problem
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	216.00	2.00	Within permissible limit at Average load during load study
		Y	247.00	2.30	
		B	251.00	2.40	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	216.00	4.20	Within permissible limit at Average load during load study
		Y	247.00	3.80	
		B	251.00	4.00	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Thycattussery					
Location & Code:		Transformer-3 (630kVA)			
Date & Time		20-01-2020 14:04 to 20-01-2020 14:09			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	244.00		Normal
		Y	240.00		
		B	241.00		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	-0.78			Leading power factor
8	Load Current (Waveform)	distorted			due to nonlinear loads
9	Load generated disturbances	Absent			Ref. Technical supplement
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	23.40	2.60	Within permissible limit at Average load during load study
		Y	23.80	2.30	
		B	20.90	2.50	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	23.40	53.00	Above permissible limit at Average load during load study
		Y	23.80	11.00	
		B	20.90	14.00	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

6

Energy efficiency in utility and process system

Specific Energy Consumption (SEC)

OTTOTRACTIONS- ENERGY AUDIT		
Energy Performance Index		
1	Total Production in (MLD)	58
2	Actual annual production M^3	21170000
3	Annual Electricity Consumption (kWh)	4752380
4	**Specific Energy Consumption kWh/m^3**	**0.22**
5	**Specific Energy Consumption m^3/kWh**	**4.45**

The Energy Performance Index (EPI)

0.22 kWh/m^3

This value may be taken as internal bench mark for future reference and improvement.

7

Evaluation of energy management system

Energy management policy

There is no written energy policy available. A draft energy management policy is given below. The management may constitute an energy management policy and display the same in the plant to motivate the staff.

KERALA WATER AUTHORITY

PH DIVISION, THYCATTUSSERY

ENERGY POLICY

(Draft)

We are committed to optimally utilize various forms of energy in a cost effective manner to effect conservation of energy resources. We are committed to conserve the energy which is a scarce resource with the requisite consistency in the efficiency, effectiveness in the cost involved in the operations and ensuring that production quality and quantity, environment, safety, health of people are maintained. We are also committed to increase the renewable energy share of the total energy we use.

We are also committed to monitor continuously the saving achieved and reduce its specific energy consumption by minimum of 2% every year.

Date ----------

Head of the Institution

7.1. Energy management monitoring system

- **Energy Management Cell** has to be constituted with an objective to revise action plan for energy conservation thereby reducing the production cost.
- Energy conservation tips/ posters are displayed in crucial points.
- Use of renewable energy has to be encouraged.
- Flow meters and energy meters shall be installed in all major pumps. The meter reading shall be recorded in regular frequencies. It is recommended to install meters with communication capability to get real-time energy performance data and monitoring of pump performance.

7.2. Training to staff responsible for operational and Documentation.

- The staff need to be made more aware of the importance of energy saving and management.
- Log books shall be maintained to record Electricity Consumption and Diesel consumption.
- TOD reading shall be taken and compared with KSEB regularly.

7.3. Renewable Energy

- No renewable energy projects implemented.

8

Energy Conservation Measures and Recommendations

KWA, Thycattussery

8.1. Electrical System

- Electrical safety measures have to be implemented.
- As , all pure water and raw water pumps are operating 24hr a day, the scheduling may be done based on the performance test results given in the 5th chapter. The motors with combined efficiency near the design efficiency may be used for regular applications and the lowest performing pumps may be used as standby.
- As per the electrical load studies conducted the capacitance requirement in demand side (motor end) is 1920 kVAR, which may cost around 8 lakhs Rs. For PF improvement. This will help increasing the PF to unity and will get incentives for the same. The demand will also come down due to better power factor.
- FCMA starters are used here which are harmonic free, rugged magnetic soft starters for motor starting. FCMA is an acronym for flux compensated magnetic amplifier which is basically a modulated inductive impedance. When connected in series with the motor the FCMA reduces the starting current to a low value. It is advised to switch all the starters to FCMA to save energy as well as to improve Switch gears & starters,
- Sub meters with communication facility shall be implemented for the effective monitoring of energy and water (like SEC)
- Pumping machinery is subjected to wear & tear, erosion and corrosion due to its nature of functioning, and therefore it is vulnerable to failures. Generally, failures or interruptions are mostly attributed to pumping machinery rather than any other component. Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast-moving spare parts. Obviously due attention needs to be paid to all such aspects for efficient and reliable functioning of pumping machinery.

- The carbon emission factor has been taken from the CO2 Baseline Database for the Indian Power Sector User Guide Version 14.0 December 2018 of Central Electricity Authority. The value take for southern grid is 0.83.
- The foundations, descaling of pipes etc. has to be checked regularly for optimizing the efficiency of the pumping system.
-

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code EA 585.01	
Energy Saving in Lighting by replacing existing 337 No's T8 Lamps	
Existing Scenario	
337 in the facility. During discussion with officers it is observed that the	
Proposed System	
The existing T8 may be replaced to LED tube of 18 W in phased	
Financial Analysis	
Annual working hours (hr)	3600
No of fittings	337
Total load (kW)	13.48
Annual Energy Consumption (kWh)	38822
Expected Annual Energy saving for replacing all fittings (kWh)	21352
Cost of Power	6.30
Annual saving in Lakhs Rs (1st year)	1.35
Investment required for complete replacements [@Rs 350 per fittings](Lakhs Rs)	1.18
Simple Pay Back (in Months)	10.52

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (301)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	55	45
		3	Efficiency of standard motor	%	90	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	48.55	29.90
		6	Efficiency	%	80	95
		7	Combined efficiency of the system (rated)	%	72	90
		8	Combined efficiency of the system (measured)	%	56	90
		9	**Head**	**m**	**43**	**43**
		10	**Flow**	**m^3/s**	**0.064**	**0.064**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**27.00**	**27.00**
	Input	14	Total Electrical Power drawn	kW	48.55	29.90
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	425298	261924
		18	Annual power Savings, kWh	kWh		163374
		19	Annual Savings	Rs. In Lakhs		**11.44**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**44.85**
		22	Investment	Rs. In Lakhs		**9.19**
		23	Simple Payback period	**Months**		**9.65**

Energy Saving Calculation

Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (101)

Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	55	45
		3	Efficiency of standard motor	%	90	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	40.00	29.80
		6	Efficiency	%	80	95
		7	Combined efficiency of the system (rated)	%	72	90
		8	Combined efficiency of the system (measured)	%	67	90
		9	**Head**	**m**	**45**	**45**
		10	**Flow**	**m^3/s**	**0.061**	**0.061**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**26.93**	**26.93**
	Input	14	Total Electrical Power drawn	kW	40.00	29.80
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	350400	261048
		18	Annual power Savings, kWh	kWh		89352
		19	Annual Savings	Rs. In Lakhs		**6.25**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**44.70**
		22	Investment	Rs. In Lakhs		**9.16**
		23	Simple Payback period	**Months**		**17.58**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (201)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	55	47
		3	Efficiency of standard motor	%	90	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	55.80	31.30
		6	Efficiency	%	80	95
		7	Combined efficiency of the system (rated)	%	72	90
		8	Combined efficiency of the system (measured)	%	51	90
		9	**Head**	**m**	**45**	**45**
		10	**Flow**	**m^3/s**	**0.064**	**0.064**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**28.25**	**28.25**
	Input	14	Total Electrical Power drawn	kW	55.80	31.30
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	488808	274188
		18	Annual power Savings, kWh	kWh		214620
		19	Annual Savings	Rs. In Lakhs		**15.02**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**46.95**
		22	Investment	Rs. In Lakhs		**9.62**
		23	Simple Payback period	**Months**		**7.69**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (501)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	164
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	135.00	109.00
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	73	90
		9	**Head**	**m**	**59**	**59**
		10	**Flow**	**m^3/s**	**0.170**	**0.170**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**98.39**	**98.39**
	Input	14	Total Electrical Power drawn	kW	135.00	109.00
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1182600	954840
		18	Annual power Savings, kWh	kWh		227760
		19	Annual Savings	Rs. In Lakhs		**15.94**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**163.50**
		22	Investment	Rs. In Lakhs		**33.52**
		23	Simple Payback period	**Months**		**25.23**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (601)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	140
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	139.00	93.60
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	61	90
		9	**Head**	**m**	**57**	**57**
		10	**Flow**	**m^3/s**	**0.151**	**0.151**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**84.43**	**84.43**
	Input	14	Total Electrical Power drawn	kW	139.00	93.60
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1217640	819936
		18	Annual power Savings, kWh	kWh		397704
		19	Annual Savings	Rs. In Lakhs		**27.84**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**140.40**
		22	Investment	Rs. In Lakhs		**28.78**
		23	Simple Payback period	**Months**		**12.41**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (701)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	149
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	161.00	99.10
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	56	90
		9	**Head**	**m**	**57**	**57**
		10	**Flow**	**m^3/s**	**0.160**	**0.160**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**89.47**	**89.47**
	Input	14	Total Electrical Power drawn	kW	161.00	99.10
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1410360	868116
		18	Annual power Savings, kWh	kWh		542244
		19	Annual Savings	Rs. In Lakhs		**37.96**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**148.65**
		22	Investment	Rs. In Lakhs		**30.47**
		23	Simple Payback period	**Months**		**9.63**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (801)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	172
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	158.00	114.80
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	66	90
		9	**Head**	**m**	**59**	**59**
		10	**Flow**	**m^3/s**	**0.179**	**0.179**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**103.60**	**103.60**
	Input	14	Total Electrical Power drawn	kW	158.00	114.80
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1384080	1005648
		18	Annual power Savings, kWh	kWh		378432
		19	Annual Savings	Rs. In Lakhs		**26.49**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**172.20**
		22	Investment	Rs. In Lakhs		**35.30**
		23	Simple Payback period	**Months**		**15.99**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (901)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	15	9
		3	Efficiency of standard motor	%	90	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	10.00	6.30
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	76.5	90
		8	Combined efficiency of the system (measured)	%	57	90
		9	**Head**	**m**	**20**	**20**
		10	**Flow**	**m^3/s**	**0.029**	**0.029**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**5.69**	**5.69**
	Input	14	Total Electrical Power drawn	kW	10.00	6.30
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	87600	55188
		18	Annual power Savings, kWh	kWh		32412
		19	Annual Savings	Rs. In Lakhs		**2.27**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**9.45**
		22	Investment	Rs. In Lakhs		**1.94**
		23	Simple Payback period	**Months**		**10.25**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1001)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	15	11
		3	Efficiency of standard motor	%	90	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	11.00	7.40
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	76.5	90
		8	Combined efficiency of the system (measured)	%	61	90
		9	**Head**	**m**	**20**	**20**
		10	**Flow**	**m^3/s**	**0.034**	**0.034**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**6.67**	**6.67**
	Input	14	Total Electrical Power drawn	kW	11.00	7.40
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	96360	64824
		18	Annual power Savings, kWh	kWh		31536
		19	Annual Savings	Rs. In Lakhs		**2.21**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**11.10**
		22	Investment	Rs. In Lakhs		**2.28**
		23	Simple Payback period	**Months**		**12.37**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1101)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	159
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	120.00	106.30
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	80	90
		9	**Head**	**m**	**60**	**60**
		10	**Flow**	**m^3/s**	**0.163**	**0.163**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**95.94**	**95.94**
	Input	14	Total Electrical Power drawn	kW	120.00	106.30
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1051200	931188
		18	Annual power Savings, kWh	kWh		120012
		19	Annual Savings	Rs. In Lakhs		**8.40**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**159.45**
		22	Investment	Rs. In Lakhs		**32.69**
		23	Simple Payback period	**Months**		**46.69**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1201)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	175
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	143.00	116.70
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	74	90
		9	**Head**	**m**	**60**	**60**
		10	**Flow**	**m^3/s**	**0.179**	**0.179**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**105.36**	**105.36**
	Input	14	Total Electrical Power drawn	kW	143.00	116.70
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1252680	1022292
		18	Annual power Savings, kWh	kWh		230388
		19	Annual Savings	Rs. In Lakhs		**16.13**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**175.05**
		22	Investment	Rs. In Lakhs		**35.89**
		23	Simple Payback period	**Months**		**26.70**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1301)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	148
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	142.00	98.80
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	63	90
		9	**Head**	**m**	**61**	**61**
		10	**Flow**	**m^3/s**	**0.149**	**0.149**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**89.16**	**89.16**
	Input	14	Total Electrical Power drawn	kW	142.00	98.80
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1243920	865488
		18	Annual power Savings, kWh	kWh		378432
		19	Annual Savings	Rs. In Lakhs		**26.49**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**148.20**
		22	Investment	Rs. In Lakhs		**30.38**
		23	Simple Payback period	**Months**		**13.76**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1401)						
Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	180	166
		3	Efficiency of standard motor	%	95	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	145.00	110.90
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	80.75	90
		8	Combined efficiency of the system (measured)	%	69	90
		9	**Head**	**m**	**59**	**59**
		10	**Flow**	**m^3/s**	**0.173**	**0.173**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**100.13**	**100.13**
	Input	14	Total Electrical Power drawn	kW	145.00	110.90
		15	Unit Cost	Rs./kWh	7	7
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1270200	971484
		18	Annual power Savings, kWh	kWh		298716
		19	Annual Savings	Rs. In Lakhs		**20.91**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**166.35**
		22	Investment	Rs. In Lakhs		**34.10**
		23	Simple Payback period	**Months**		**19.57**

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code EA 585.15	
Energy Saving in Lighting by replacing existing 36 No's 250W	
Existing Scenario	
36 in the facility. During discussion with officers it is observed that the	
Proposed System	
The existing SV may be replaced to LED of 150 W in phased manner	
Financial Analysis	
Annual working hours (hr)	3600
No of fittings	36
Total load (kW)	9.00
Annual Energy Consumption (kWh)	25920
Expected Annual Energy saving for replacing all fittings (kWh)	10368
Cost of Power	6.30
Annual saving in Lakhs Rs (1st year)	0.65
Investment required for complete replacements [@Rs 2550 per fittings](Lakhs Rs)	0.92
Simple Pay Back (in Months)	16.87

OTTOTRACTIONS- ENERGY AUDIT						
KWA WTP- THYCATTUSSERY						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Energy Saving in Lighting by replacing existing 337 No's T8 Lamps to 18W LED Tube	38822	38.82	10	28.34	283.40
2	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (301)	163374	163.37	10	119.26	1192.63
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (101)	89352	89.35	10	65.23	652.27
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (201)	214620	214.62	10	156.67	1566.73
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (501)	227760	227.76	10	166.26	1662.65
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (601)	397704	397.70	10	290.32	2903.24
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (701)	542244	542.24	10	395.84	3958.38

8	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (801)	378432	378.43	10	276.26	2762.55
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (901)	32412.00	506.17	10.00	369.50	3695.03
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1001)	31536.00	695.11	10.00	507.43	5074.27
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1101)	120012.00	929.44	10.00	678.49	6784.88
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1201)	230388.00	1382.33	10.00	1009.10	10090.99
13	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1301)	378432.00	1546.14	10.00	1128.68	11286.82
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1401)	298716.00	1824.55	10.00	1331.92	13319.20
15	Energy Saving in Lighting by replacing existing 36 No's 250W Sodium vapour Lamps to 150W LED.	10368.00	2121.95	10.00	1549.02	15490.24

OTTOTRACTIONS- ENERGY AUDIT			
Implementation Schedule			
KWA WTP- THYCATTUSSERY			
Sl No	Projects	SPB	Implementation Schedule
1	Energy Saving in Lighting by replacing existing 337 No's T8 Lamps to 18W LED Tube	10.52	Medium Term
2	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (301)	9.65	Medium Term
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (101)	17.58	Medium Term
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (201)	7.69	Medium Term
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (501)	25.23	Medium Term
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (601)	12.41	Medium Term
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (701)	9.63	Medium Term
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (801)	15.99	Medium Term
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (901)	13.59	Medium Term

10	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1001)	13.97	Medium Term
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1101)	14.51	Medium Term
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1201)	14.13	Medium Term
13	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1301)	14.93	Medium Term
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump Zone 1 (1401)	13.64	Medium Term
15	Energy Saving in Lighting by replacing existing 36 No's 250W Sodium vapour Lamps to 150W LED.	13.80	Medium Term

9

Technical Supplement

Electricity Bill Details (2018-2019)												
Month	Name of the Consumer				KERALA WATER AUTHORITY, KWA, WT PLANT THYKKATTUSSERY							
	Contract demand		1374		Consumer number & Section			1355140011241				
	Tariff		HT I (A) INDUSTRIAL					Poochakkal				
	kWh				kVA			PF	Power factor		` (Total)	` Rs/ kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3		Penalty	Incentive		
Apr	234260	93280	147980	475520	840	858	842	0.93	0	39230	2944870	**6.1929**
May	148620	63880	100320	312820	831	833	834	0.97	0	60218	2008695	**6.4212**
Jun	138080	39720	91960	269760	880	871	871	0.89	14836.8	0	1841537	**6.8266**
Jul	210760	82540	136160	429460	873	865	830	0.93	0	35430	2689582	**6.2627**
Aug	209080	77880	125360	412320	876	887	856	0.91	0	11339	2617261	**6.3476**
Sep	197340	71500	113660	382500	877	862	845	0.94	0	42075	2418788	**6.3236**
Oct	204840	82860	131720	419420	872	882	820	0.93	0	34602	2696848	**6.4299**
Nov	222280	83260	133920	439460	834	857	799	0.94	0	48341	2798841	**6.3688**
Dec	198780	72280	118800	389860	869	893	845	0.92	0	21442	2539299	**6.5134**
Jan	211940	86200	138760	436900	850	855	819	0.94	0	48059	2718804	**6.2229**
Feb	209420	84860	129600	423880	910	944	916	0.91	0	11657	2681968	**6.3272**
Mar	179200	67980	113300	360480	826	849	829	0.94		39653	2297347	**6.373**

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Thycattussery
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
Average value in the period		243.80	239.67	241.08	23.51	23.73	20.88	13.03	4.85	4.82	3.36	-10.04	-3.05
Maximum value in the period		245.31	241.09	242.55	23.84	24.02	21.08	13.16	4.96	4.88	3.46	-9.93	-3.02
Time of maximum value		20-01-2020 14:04:14	20-01-2020 14:04:48	20-01-2020 14:04:14	20-01-2020 14:04:16	20-01-2020 14:11:28	20-01-2020 14:09:12	20-01-2020 14:08:48	20-01-2020 14:04:14	20-01-2020 14:10:50	20-01-2020 14:09:12	20-01-2020 14:07:18	20-01-2020 14:11:12
Minimum value in the period		242.20	237.98	239.41	23.37	23.30	20.43	12.90	4.80	4.69	3.26	-10.18	-3.10
Time of minimum value		20-01-2020 14:11:30	20-01-2020 14:12:56	20-01-2020 14:12:56	20-01-2020 14:08:12	20-01-2020 14:04:08	20-01-2020 14:04:20	20-01-2020 14:04:36	20-01-2020 14:11:30	20-01-2020 14:04:08	20-01-2020 14:04:40	20-01-2020 14:04:24	20-01-2020 14:04:12
20-01-2020	14:04:02												
	14:04:04	245.11	240.90	242.47	23.73	23.31	20.47	12.94	4.93	4.70	3.32	-10.07	-3.09
	14:04:06	245.13	240.92	242.52	23.76	23.32	20.46	12.95	4.94	4.70	3.31	-10.07	-3.09
	14:04:08	245.12	240.88	242.46	23.79	23.30	20.46	12.94	4.94	4.69	3.30	-10.09	-3.09
	14:04:10	245.11	240.83	242.43	23.80	23.32	20.47	12.94	4.95	4.69	3.30	-10.10	-3.09
	14:04:12	245.22	240.93	242.49	23.82	23.30	20.45	12.94	4.95	4.69	3.30	-10.10	-3.10
	14:04:14	245.31	240.98	242.55	23.83	23.31	20.45	12.94	4.96	4.69	3.29	-10.11	-3.10
	14:04:16	245.28	241.01	242.51	23.84	23.31	20.44	12.95	4.96	4.70	3.29	-10.11	-3.10
	14:04:18	245.24	240.98	242.45	23.84	23.31	20.43	12.94	4.96	4.70	3.28	-10.10	-3.10
	14:04:20	245.14	240.95	242.35	23.84	23.32	20.43	12.94	4.96	4.70	3.28	-10.10	-3.10
	14:04:22	245.12	240.94	242.39	23.61	23.43	20.61	12.93	4.90	4.75	3.29	-10.14	-3.09
	14:04:24	245.05	240.90	242.33	23.45	23.56	20.75	12.93	4.85	4.80	3.28	-10.18	-3.08
	14:04:26	245.03	240.89	242.31	23.47	23.56	20.74	12.93	4.86	4.79	3.28	-10.17	-3.08
	14:04:28	245.01	240.90	242.29	23.45	23.53	20.74	12.92	4.85	4.79	3.28	-10.17	-3.08
	14:04:30	244.96	240.85	242.24	23.47	23.51	20.73	12.92	4.86	4.78	3.28	-10.16	-3.08
	14:04:32	245.02	240.93	242.29	23.49	23.49	20.72	12.91	4.86	4.78	3.27	-10.17	-3.08
	14:04:34	245.00	240.89	242.28	23.47	23.48	20.71	12.90	4.86	4.77	3.27	-10.17	-3.08
	14:04:36	245.01	240.92	242.28	23.49	23.47	20.70	12.90	4.86	4.77	3.27	-10.17	-3.08
	14:04:38	244.97	240.92	242.23	23.48	23.46	20.70	12.90	4.86	4.78	3.27	-10.16	-3.08
	14:04:40	244.88	240.83	242.13	23.48	23.46	20.70	12.90	4.86	4.78	3.26	-10.15	-3.08
	14:04:42	244.90	240.92	242.19	23.48	23.49	20.68	12.90	4.86	4.78	3.26	-10.16	-3.08
	14:04:44	244.90	240.94	242.16	23.51	23.48	20.68	12.90	4.86	4.78	3.26	-10.17	-3.09
	14:04:46	244.89	240.95	242.13	23.52	23.49	20.68	12.90	4.87	4.79	3.26	-10.17	-3.09
	14:04:48	245.03	241.09	242.28	23.50	23.48	20.67	12.91	4.86	4.79	3.26	-10.16	-3.09
	14:04:50	245.03	241.04	242.27	23.50	23.50	20.68	12.92	4.86	4.79	3.26	-10.16	-3.09
	14:04:52	244.99	240.97	242.26	23.48	23.51	20.69	12.91	4.85	4.79	3.27	-10.16	-3.09
	14:04:54	245.00	240.92	242.21	23.50	23.51	20.70	12.92	4.86	4.79	3.27	-10.16	-3.09
	14:04:56	244.96	240.88	242.19	23.49	23.54	20.72	12.93	4.86	4.80	3.27	-10.16	-3.08
	14:04:58	244.91	240.84	242.13	23.48	23.54	20.71	12.92	4.85	4.80	3.27	-10.16	-3.08
	14:05:00	244.85	240.79	242.10	23.49	23.55	20.73	12.93	4.86	4.80	3.28	-10.15	-3.08
	14:05:02	244.77	240.74	242.02	23.48	23.54	20.73	12.93	4.85	4.80	3.28	-10.14	-3.08
	14:05:04	244.83	240.83	242.09	23.50	23.53	20.70	12.93	4.86	4.80	3.27	-10.14	-3.08
	14:05:06	244.81	240.79	242.03	23.51	23.53	20.72	12.93	4.86	4.80	3.28	-10.14	-3.08
	14:05:08	244.87	240.83	242.11	23.50	23.54	20.74	12.94	4.86	4.80	3.28	-10.15	-3.08
	14:05:10	244.85	240.80	242.10	23.50	23.56	20.74	12.95	4.86	4.80	3.28	-10.15	-3.08
	14:05:12	244.88	240.80	242.12	23.49	23.55	20.74	12.95	4.86	4.80	3.29	-10.15	-3.08
	14:05:14	244.84	240.78	242.07	23.51	23.57	20.75	12.96	4.86	4.81	3.29	-10.14	-3.08
	14:05:16	244.84	240.80	242.07	23.51	23.58	20.76	12.97	4.87	4.81	3.29	-10.14	-3.08
	14:05:18	244.82	240.79	242.12	23.49	23.60	20.77	12.97	4.86	4.81	3.30	-10.14	-3.08
	14:05:20	244.82	240.75	242.12	23.50	23.60	20.75	12.97	4.87	4.81	3.29	-10.13	-3.07
	14:05:22	244.73	240.66	242.00	23.50	23.61	20.76	12.97	4.86	4.81	3.30	-10.13	-3.08
	14:05:24	244.81	240.76	242.10	23.53	23.61	20.77	12.99	4.88	4.82	3.30	-10.14	-3.07

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Thycattussery
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)

Date	Time	Q2[kvar]	Q3[kvar]	S[kVA]	S1[kVA]
Average value in the period		-3.02	-3.74	16.45	5.73
Maximum value in the period		-3.01	-3.66	16.54	5.85
Time of maximum value		20-01-2020 14:05:30	20-01-2020 14:07:18	20-01-2020 14:08:48	20-01-2020 14:04:16
Minimum value in the period		-3.09	-3.81	16.39	5.68
Time of minimum value		20-01-2020 14:04:06	20-01-2020 14:04:24	20-01-2020 14:07:18	20-01-2020 14:11:28
20-01-2020	14:04:02				
	14:04:04	-3.08	-3.69	16.40	5.82
	14:04:06	-3.09	-3.70	16.41	5.83
	14:04:08	-3.08	-3.70	16.41	5.83
	14:04:10	-3.09	-3.70	16.41	5.84
	14:04:12	-3.09	-3.71	16.42	5.84
	14:04:14	-3.09	-3.71	16.42	5.85
	14:04:16	-3.09	-3.71	16.43	5.85
	14:04:18	-3.08	-3.71	16.42	5.85
	14:04:20	-3.08	-3.71	16.41	5.85
	14:04:22	-3.06	-3.77	16.43	5.79
	14:04:24	-3.04	-3.81	16.45	5.75
	14:04:26	-3.04	-3.81	16.45	5.75
	14:04:28	-3.03	-3.81	16.44	5.75
	14:04:30	-3.03	-3.81	16.44	5.75
	14:04:32	-3.03	-3.81	16.44	5.76
	14:04:34	-3.04	-3.81	16.43	5.75
	14:04:36	-3.03	-3.80	16.42	5.76
	14:04:38	-3.03	-3.80	16.42	5.75
	14:04:40	-3.02	-3.80	16.41	5.75
	14:04:42	-3.02	-3.80	16.42	5.75
	14:04:44	-3.03	-3.80	16.43	5.76
	14:04:46	-3.03	-3.80	16.43	5.76
	14:04:48	-3.02	-3.80	16.43	5.76
	14:04:50	-3.02	-3.81	16.43	5.76
	14:04:52	-3.02	-3.80	16.43	5.75
	14:04:54	-3.03	-3.80	16.43	5.76
	14:04:56	-3.03	-3.80	16.44	5.76
	14:04:58	-3.02	-3.80	16.44	5.75
	14:05:00	-3.02	-3.80	16.44	5.75
	14:05:02	-3.02	-3.80	16.43	5.75
	14:05:04	-3.02	-3.80	16.43	5.75
	14:05:06	-3.02	-3.80	16.43	5.75
	14:05:08	-3.02	-3.80	16.44	5.75
	14:05:10	-3.02	-3.80	16.45	5.75
	14:05:12	-3.02	-3.80	16.45	5.75
	14:05:14	-3.02	-3.80	16.45	5.76
	14:05:16	-3.02	-3.80	16.46	5.76
	14:05:18	-3.02	-3.79	16.46	5.75
	14:05:20	-3.03	-3.79	16.46	5.76
	14:05:22	-3.02	-3.79	16.46	5.75
	14:05:24	-3.02	-3.79	16.47	5.76

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Thycattussery		
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)		

Date	Time	Q2[kvar]	Q3[kvar]	S[kVA]	S1[kVA]
20-01-2020	14:05:26	-3.02	-3.79	16.47	5.76
	14:05:28	-3.02	-3.79	16.46	5.75
	14:05:30	-3.01	-3.80	16.45	5.76
	14:05:32	-3.01	-3.79	16.45	5.75
	14:05:34	-3.01	-3.80	16.46	5.76
	14:05:36	-3.01	-3.80	16.48	5.77
	14:05:38	-3.01	-3.80	16.47	5.76
	14:05:40	-3.01	-3.79	16.45	5.75
	14:05:42	-3.02	-3.79	16.45	5.74
	14:05:44	-3.01	-3.79	16.45	5.75
	14:05:46	-3.01	-3.79	16.46	5.76
	14:05:48	-3.01	-3.79	16.45	5.75
	14:05:50	-3.02	-3.78	16.44	5.74
	14:05:52	-3.02	-3.78	16.45	5.74
	14:05:54	-3.03	-3.79	16.45	5.74
	14:05:56	-3.02	-3.79	16.45	5.74
	14:05:58	-3.03	-3.81	16.46	5.73
	14:06:00	-3.02	-3.78	16.46	5.74
	14:06:02	-3.02	-3.81	16.50	5.74
	14:06:04	-3.02	-3.81	16.50	5.75
	14:06:06	-3.03	-3.81	16.49	5.73
	14:06:08	-3.05	-3.79	16.49	5.72
	14:06:10	-3.05	-3.79	16.49	5.72
	14:06:12	-3.05	-3.80	16.48	5.72
	14:06:14	-3.04	-3.80	16.48	5.72
	14:06:16	-3.04	-3.80	16.48	5.72
	14:06:18	-3.04	-3.80	16.48	5.72
	14:06:20	-3.04	-3.80	16.48	5.72
	14:06:22	-3.03	-3.80	16.47	5.72
	14:06:24	-3.04	-3.80	16.48	5.72
	14:06:26	-3.04	-3.80	16.48	5.72
	14:06:28	-3.04	-3.80	16.48	5.72
	14:06:30	-3.03	-3.80	16.49	5.73
	14:06:32	-3.04	-3.80	16.47	5.71
	14:06:34	-3.03	-3.80	16.47	5.72
	14:06:36	-3.04	-3.80	16.48	5.71
	14:06:38	-3.03	-3.80	16.48	5.71
	14:06:40	-3.04	-3.80	16.47	5.71
	14:06:42	-3.04	-3.80	16.47	5.71
	14:06:44	-3.04	-3.80	16.48	5.71
	14:06:46	-3.04	-3.80	16.47	5.71
	14:06:48	-3.04	-3.80	16.47	5.71
	14:06:50	-3.03	-3.81	16.48	5.72
	14:06:52	-3.03	-3.81	16.47	5.72
	14:06:54	-3.03	-3.81	16.48	5.72
	14:06:56	-3.03	-3.80	16.47	5.72
	14:06:58	-3.03	-3.81	16.47	5.72
	14:07:00	-3.03	-3.80	16.46	5.72
	14:07:02	-3.03	-3.80	16.47	5.72

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

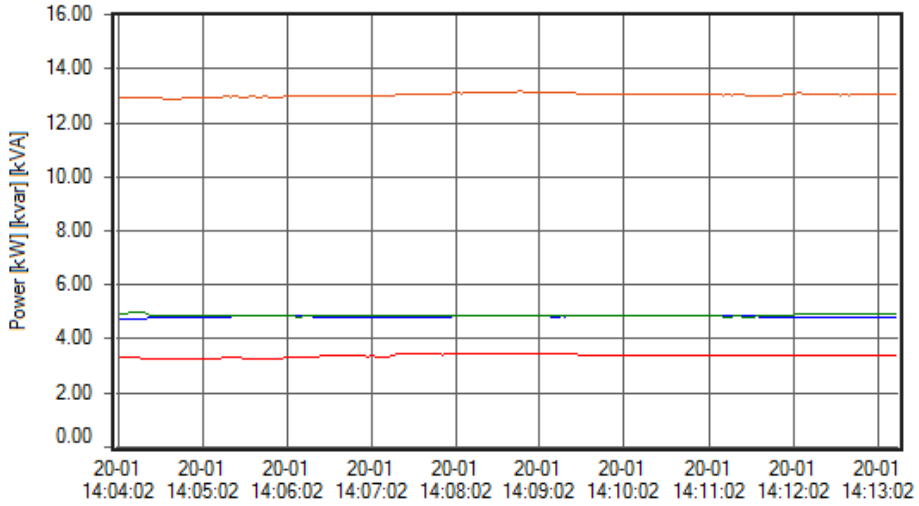
Title	KWA Thycattussery
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)

Date	Time	S2[kVA]	S3[kVA]	PF	PF1	PF2	PF3	WP+[kWh]	Pdem+[kW]
20-01-2020	14:05:26	5.69	5.03	-0.7886	-0.8460	-0.8477	-0.6560	0.302	12.99
	14:05:28	5.69	5.02	-0.7880	-0.8448	-0.8479	-0.6553	0.309	12.97
	14:05:30	5.68	5.02	-0.7880	-0.8451	-0.8483	-0.6541	0.316	12.96
	14:05:32	5.69	5.01	-0.7879	-0.8449	-0.8486	-0.6536	0.323	12.96
	14:05:34	5.69	5.02	-0.7881	-0.8449	-0.8491	-0.6536	0.331	12.97
	14:05:36	5.69	5.02	-0.7879	-0.8443	-0.8489	-0.6541	0.338	12.98
	14:05:38	5.69	5.02	-0.7880	-0.8447	-0.8486	-0.6544	0.345	12.98
	14:05:40	5.69	5.02	-0.7880	-0.8440	-0.8482	-0.6553	0.352	12.97
	14:05:42	5.69	5.01	-0.7879	-0.8439	-0.8483	-0.6552	0.359	12.96
	14:05:44	5.69	5.01	-0.7881	-0.8447	-0.8487	-0.6542	0.367	12.96
	14:05:46	5.69	5.01	-0.7880	-0.8445	-0.8489	-0.6539	0.374	12.97
	14:05:48	5.69	5.01	-0.7880	-0.8448	-0.8487	-0.6538	0.381	12.97
	14:05:50	5.70	5.01	-0.7881	-0.8447	-0.8480	-0.6551	0.388	12.96
	14:05:52	5.70	5.01	-0.7880	-0.8443	-0.8478	-0.6555	0.395	12.96
	14:05:54	5.70	5.01	-0.7881	-0.8449	-0.8479	-0.6550	0.403	12.97
	14:05:56	5.71	5.01	-0.7882	-0.8452	-0.8481	-0.6547	0.410	12.96
	14:05:58	5.70	5.03	-0.7872	-0.8452	-0.8476	-0.6524	0.417	12.95
	14:06:00	5.70	5.02	-0.7891	-0.8455	-0.8483	-0.6574	0.424	12.99
	14:06:02	5.71	5.05	-0.7885	-0.8458	-0.8484	-0.6558	0.431	13.01
	14:06:04	5.71	5.05	-0.7884	-0.8456	-0.8484	-0.6558	0.439	13.01
	14:06:06	5.71	5.05	-0.7881	-0.8440	-0.8475	-0.6575	0.446	13.00
	14:06:08	5.72	5.05	-0.7877	-0.8417	-0.8463	-0.6600	0.453	12.99
	14:06:10	5.73	5.05	-0.7877	-0.8416	-0.8463	-0.6601	0.460	12.99
	14:06:12	5.72	5.05	-0.7879	-0.8421	-0.8463	-0.6603	0.467	12.99
	14:06:14	5.71	5.06	-0.7880	-0.8430	-0.8462	-0.6602	0.475	12.99
	14:06:16	5.70	5.06	-0.7881	-0.8434	-0.8462	-0.6602	0.482	12.99
	14:06:18	5.70	5.06	-0.7883	-0.8434	-0.8462	-0.6611	0.489	12.99
	14:06:20	5.70	5.07	-0.7884	-0.8435	-0.8461	-0.6614	0.496	12.99
	14:06:22	5.69	5.07	-0.7882	-0.8434	-0.8458	-0.6613	0.504	12.98
	14:06:24	5.69	5.07	-0.7883	-0.8438	-0.8455	-0.6616	0.511	12.99
	14:06:26	5.69	5.07	-0.7884	-0.8438	-0.8458	-0.6616	0.518	12.99
	14:06:28	5.68	5.08	-0.7886	-0.8443	-0.8456	-0.6620	0.525	12.99
	14:06:30	5.68	5.08	-0.7891	-0.8452	-0.8456	-0.6624	0.532	13.01
	14:06:32	5.68	5.08	-0.7885	-0.8444	-0.8450	-0.6627	0.540	12.98
	14:06:34	5.67	5.08	-0.7888	-0.8449	-0.8454	-0.6625	0.547	12.99
	14:06:36	5.69	5.07	-0.7891	-0.8444	-0.8459	-0.6631	0.554	13.00
	14:06:38	5.69	5.07	-0.7890	-0.8444	-0.8462	-0.6625	0.561	13.00
	14:06:40	5.69	5.07	-0.7888	-0.8445	-0.8458	-0.6621	0.569	12.99
	14:06:42	5.69	5.07	-0.7888	-0.8445	-0.8457	-0.6624	0.576	12.99
	14:06:44	5.69	5.08	-0.7891	-0.8451	-0.8457	-0.6627	0.583	13.00
	14:06:46	5.69	5.07	-0.7891	-0.8452	-0.8459	-0.6623	0.590	13.00
	14:06:48	5.69	5.07	-0.7889	-0.8451	-0.8459	-0.6618	0.597	13.00
	14:06:50	5.69	5.08	-0.7890	-0.8452	-0.8459	-0.6619	0.605	13.00
	14:06:52	5.69	5.07	-0.7888	-0.8450	-0.8460	-0.6616	0.612	13.00
	14:06:54	5.69	5.07	-0.7890	-0.8452	-0.8462	-0.6617	0.619	13.00
	14:06:56	5.68	5.07	-0.7890	-0.8453	-0.8462	-0.6615	0.626	12.99
	14:06:58	5.68	5.07	-0.7889	-0.8453	-0.8461	-0.6612	0.633	12.99
	14:07:00	5.67	5.07	-0.7887	-0.8452	-0.8458	-0.6611	0.641	12.99
	14:07:02	5.68	5.07	-0.7890	-0.8455	-0.8460	-0.6614	0.648	12.99

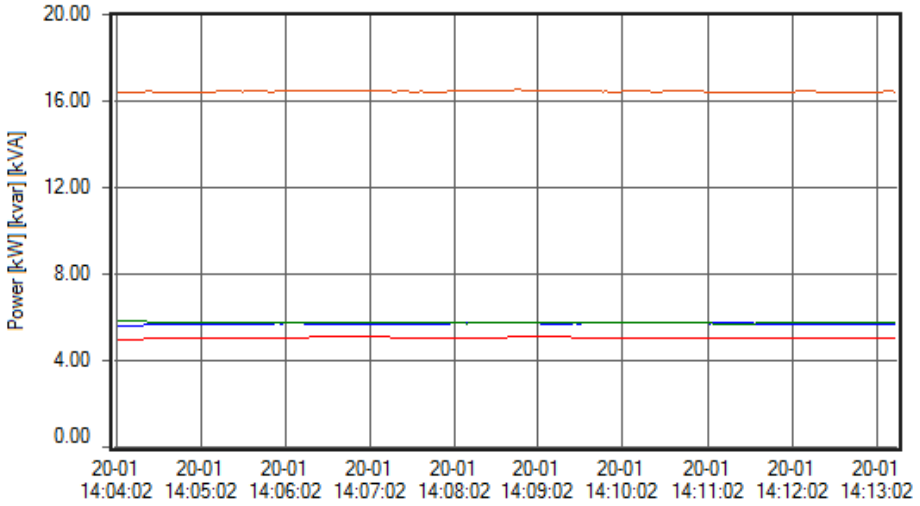
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

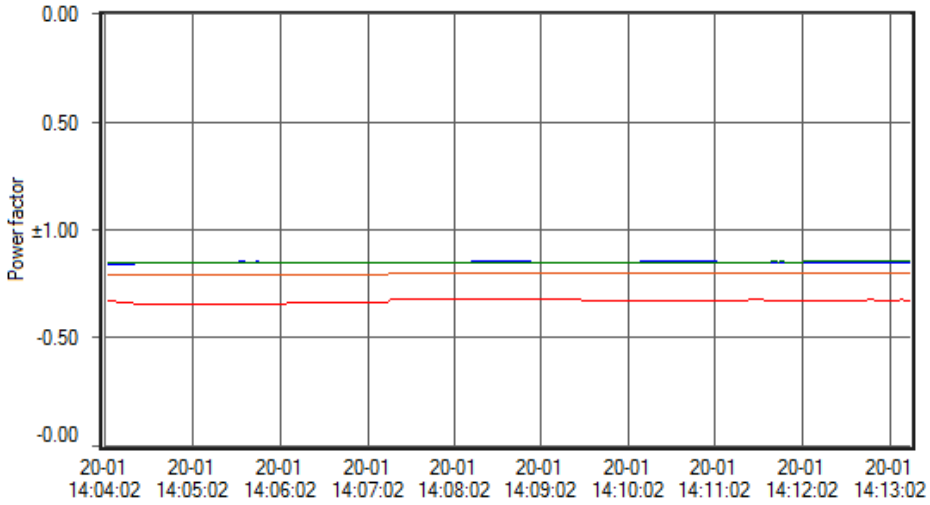
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

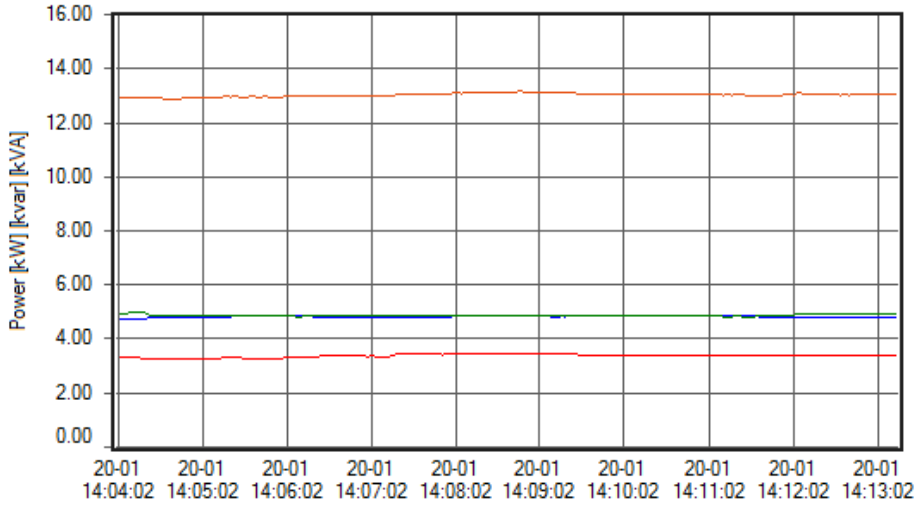


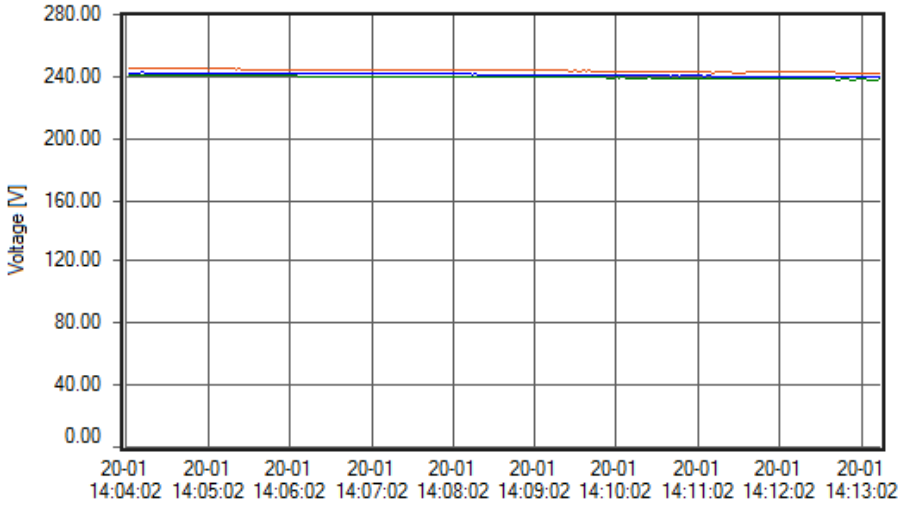
Left axis
PF PF1 PF2 PF3

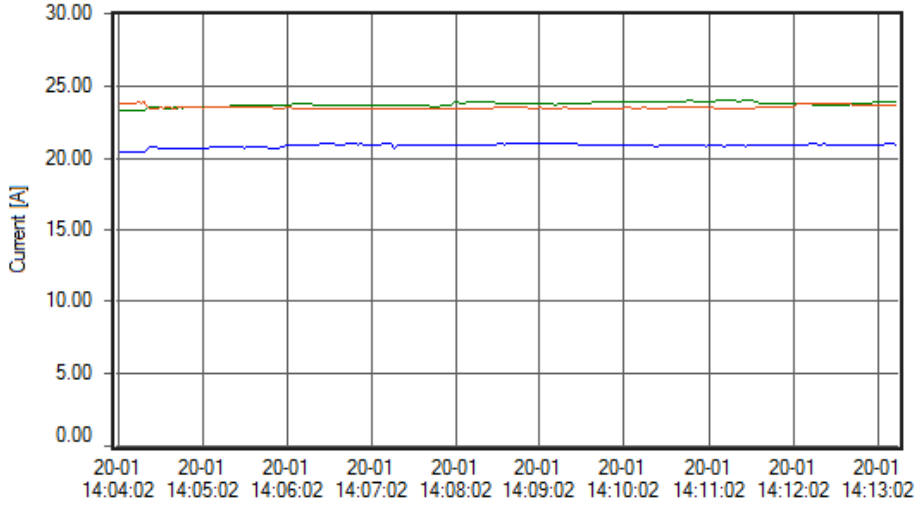
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

Title	KWA Thycattussery
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)



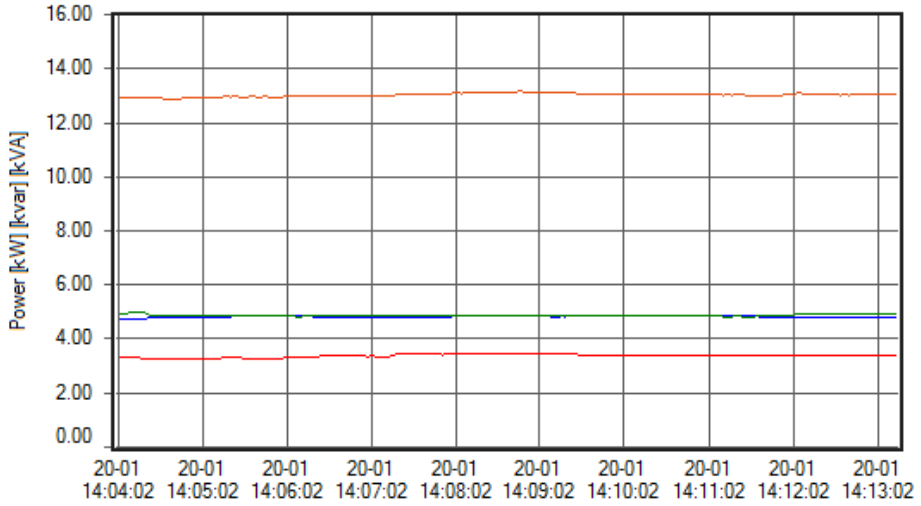




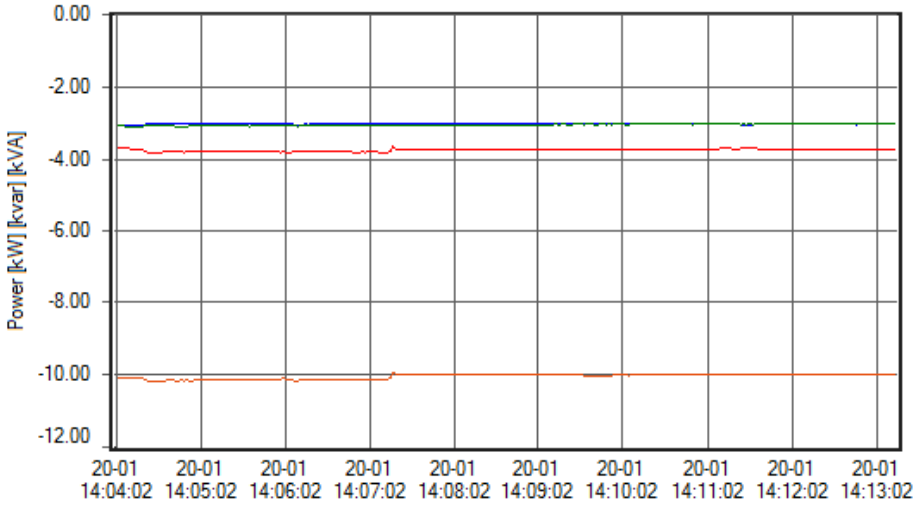
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

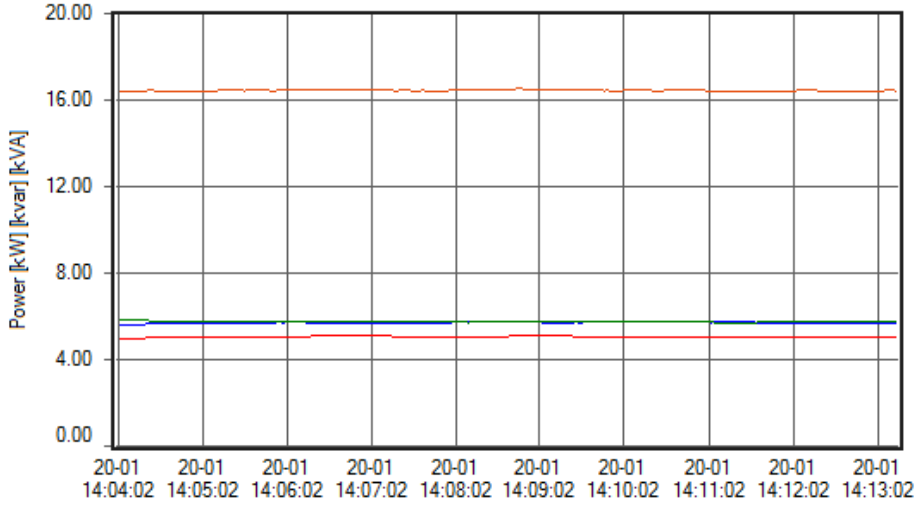
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
Q[kvar] Q1[kvar] Q2[kvar] Q3[kvar]

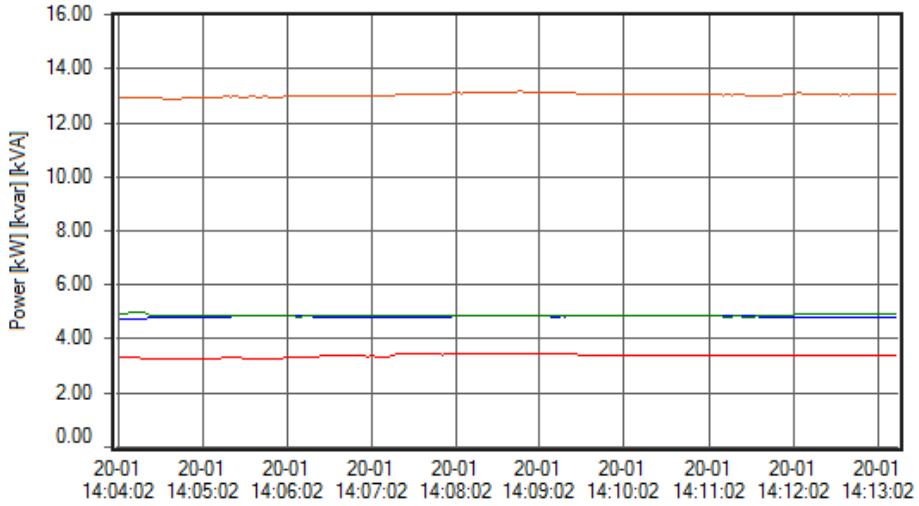


Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

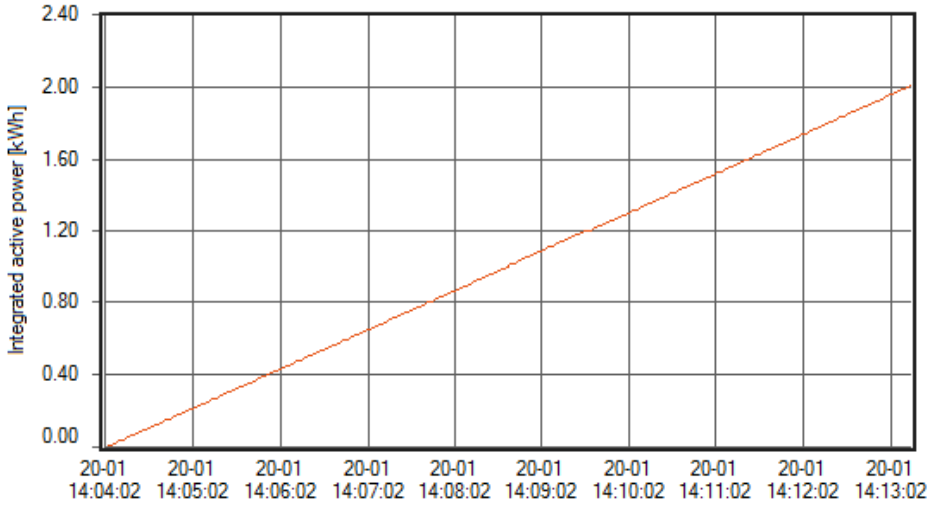
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

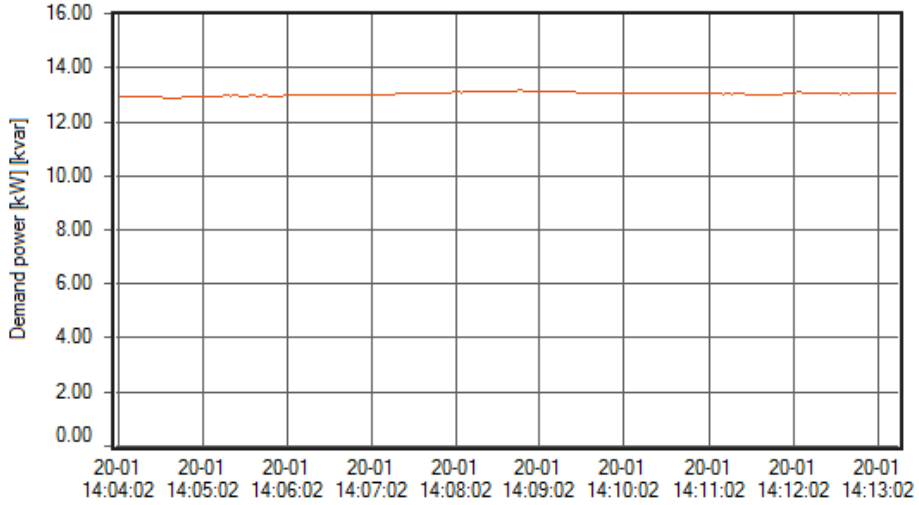
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Display period	20-01-2020 14:04:02 - 20-01-2020 14:13:16		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-3 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
WP+[kWh]



Left axis
Pdem+[kW]

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

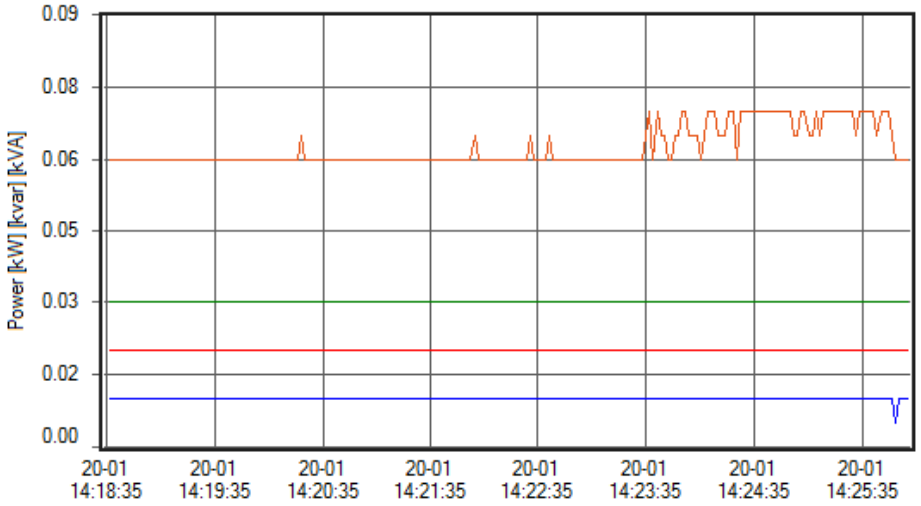
Title	KWA Thycattussery
Measurement period	20-01-2020 14:18:35 - 20-01-2020 14:26:02
Display period	20-01-2020 14:18:35 - 20-01-2020 14:26:01
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-4 (630kVA)

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
Average value in the period		245.01	246.67	249.61	26.47	26.43	26.82	0.06	0.03	0.01	0.02	-19.70	-6.49
Maximum value in the period		245.73	247.54	250.22	26.56	26.52	26.92	0.07	0.03	0.01	0.02	-19.62	-6.45
Time of maximum value		20-01-2020 14:21:27	20-01-2020 14:21:01	20-01-2020 14:21:27	20-01-2020 14:21:15	20-01-2020 14:21:29	20-01-2020 14:21:27	20-01-2020 14:23:37	20-01-2020 14:18:37	20-01-2020 14:18:37	20-01-2020 14:18:37	20-01-2020 14:20:37	20-01-2020 14:20:37
Minimum value in the period		244.19	246.11	248.56	26.40	26.36	26.76	0.06	0.03	0.01	0.02	-19.82	-6.53
Time of minimum value		20-01-2020 14:20:37	20-01-2020 14:24:27	20-01-2020 14:20:37	20-01-2020 14:23:47	20-01-2020 14:24:25	20-01-2020 14:23:47	20-01-2020 14:18:37	20-01-2020 14:18:37	20-01-2020 14:25:53	20-01-2020 14:18:37	20-01-2020 14:21:27	20-01-2020 14:21:27
20-01-2020	14:18:35												
	14:18:37	244.79	246.27	249.42	26.48	26.39	26.81	0.06	0.03	0.01	0.02	-19.67	-6.48
	14:18:39	244.86	246.32	249.42	26.49	26.40	26.81	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:18:41	244.93	246.33	249.54	26.50	26.41	26.83	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:18:43	244.84	246.26	249.47	26.49	26.40	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:18:45	244.88	246.29	249.49	26.50	26.40	26.83	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:18:47	244.96	246.33	249.54	26.50	26.40	26.83	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:18:49	244.97	246.34	249.54	26.50	26.40	26.83	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:18:51	245.03	246.40	249.61	26.50	26.40	26.83	0.06	0.03	0.01	0.02	-19.70	-6.49
	14:18:53	244.98	246.40	249.62	26.49	26.40	26.83	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:18:55	244.94	246.35	249.59	26.48	26.39	26.82	0.06	0.03	0.01	0.02	-19.68	-6.48
	14:18:57	244.93	246.34	249.60	26.47	26.38	26.82	0.06	0.03	0.01	0.02	-19.68	-6.48
	14:18:59	244.96	246.39	249.61	26.48	26.38	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:01	244.98	246.39	249.59	26.48	26.39	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:03	245.00	246.39	249.60	26.48	26.39	26.82	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:05	245.04	246.41	249.64	26.48	26.39	26.82	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:07	245.01	246.39	249.64	26.48	26.39	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:09	244.99	246.39	249.64	26.47	26.38	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:11	245.01	246.43	249.66	26.47	26.39	26.82	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:13	245.06	246.49	249.70	26.47	26.39	26.81	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:15	245.08	246.49	249.72	26.47	26.39	26.82	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:17	245.02	246.50	249.70	26.47	26.39	26.82	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:19	245.01	246.53	249.68	26.47	26.40	26.82	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:21	245.12	246.64	249.69	26.49	26.42	26.82	0.06	0.03	0.01	0.02	-19.71	-6.49
	14:19:23	245.17	246.72	249.72	26.49	26.43	26.83	0.06	0.03	0.01	0.02	-19.71	-6.50
	14:19:25	245.08	246.62	249.63	26.49	26.42	26.82	0.06	0.03	0.01	0.02	-19.70	-6.49
	14:19:27	245.11	246.65	249.55	26.48	26.42	26.80	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:29	245.05	246.65	249.45	26.46	26.41	26.78	0.06	0.03	0.01	0.02	-19.68	-6.49
	14:19:31	245.09	246.65	249.49	26.47	26.42	26.79	0.06	0.03	0.01	0.02	-19.69	-6.49
	14:19:33	245.16	246.76	249.58	26.49	26.44	26.81	0.06	0.03	0.01	0.02	-19.71	-6.49
	14:19:35	245.20	246.83	249.61	26.50	26.44	26.81	0.06	0.03	0.01	0.02	-19.72	-6.50
	14:19:37	245.26	246.90	249.55	26.50	26.45	26.81	0.06	0.03	0.01	0.02	-19.72	-6.50
	14:19:39	245.22	246.88	249.50	26.50	26.45	26.80	0.06	0.03	0.01	0.02	-19.72	-6.50
	14:19:41	245.24	246.89	249.49	26.50	26.45	26.80	0.06	0.03	0.01	0.02	-19.71	-6.50
	14:19:43	245.22	246.89	249.49	26.49	26.44	26.80	0.06	0.03	0.01	0.02	-19.71	-6.50
	14:19:45	245.19	246.94	249.56	26.48	26.45	26.80	0.06	0.03	0.01	0.02	-19.72	-6.49
	14:19:47	245.16	246.98	249.62	26.49	26.45	26.81	0.06	0.03	0.01	0.02	-19.72	-6.49
	14:19:49	245.22	247.00	249.70	26.49	26.46	26.82	0.06	0.03	0.01	0.02	-19.73	-6.50
	14:19:51	245.22	247.00	249.73	26.49	26.46	26.83	0.06	0.03	0.01	0.02	-19.73	-6.50
	14:19:53	245.12	246.89	249.65	26.48	26.45	26.83	0.06	0.03	0.01	0.02	-19.72	-6.49
	14:19:55	245.09	246.92	249.59	26.49	26.45	26.82	0.06	0.03	0.01	0.02	-19.72	-6.49
	14:19:57	245.07	246.85	249.54	26.48	26.45	26.81	0.06	0.03	0.01	0.02	-19.71	-6.49

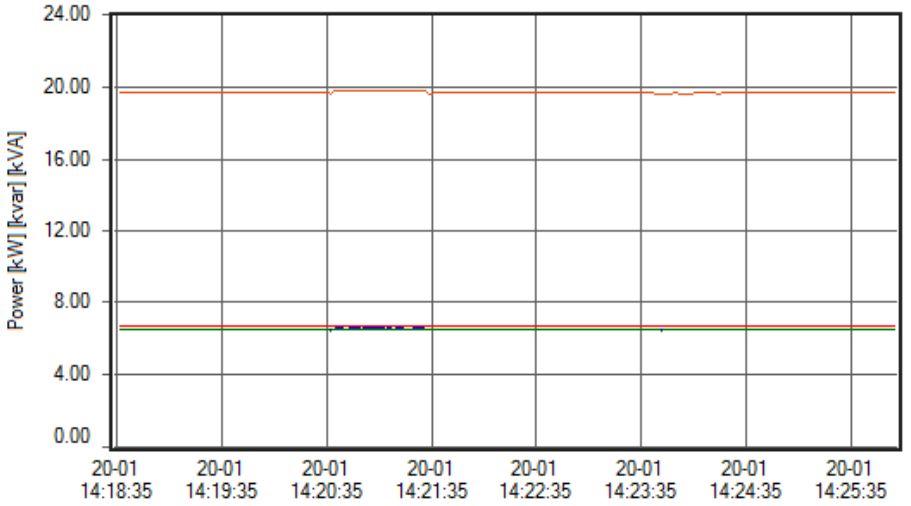
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

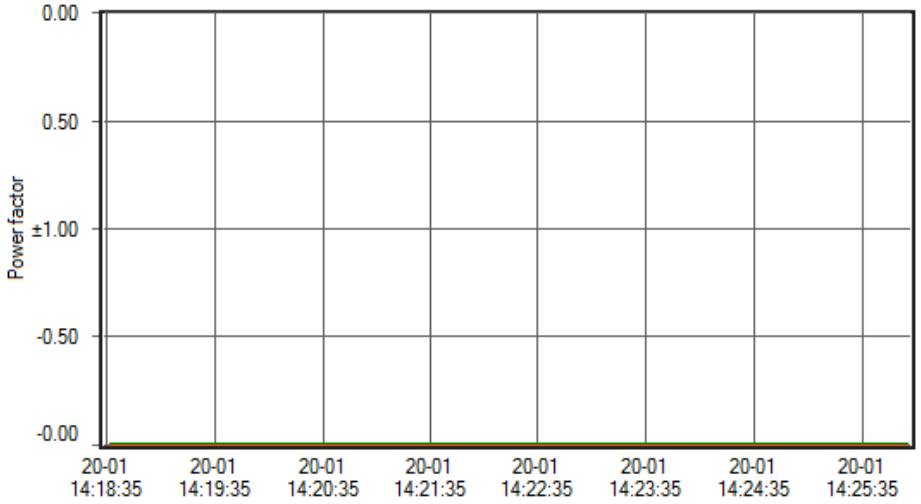
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:18:35 - 20-01-2020 14:26:02		
Display period	20-01-2020 14:18:35 - 20-01-2020 14:26:01		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-4 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

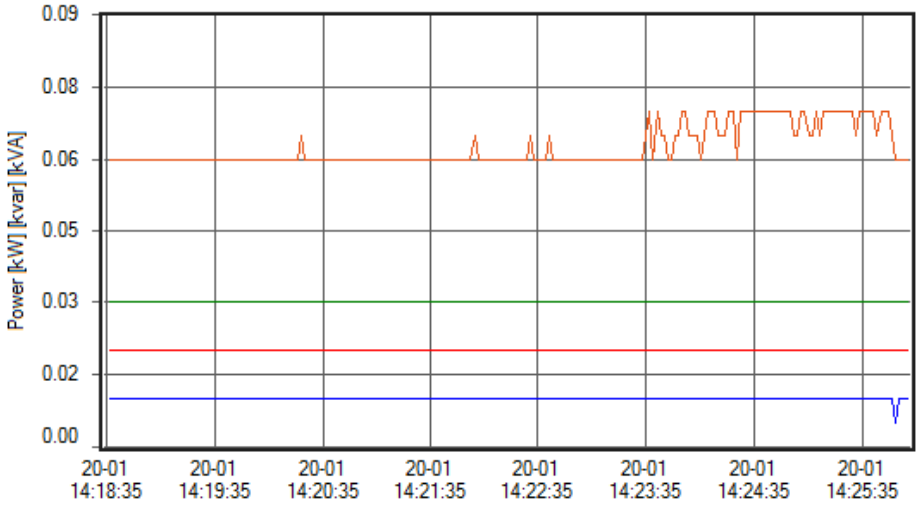


Left axis
PF PF1 PF2 PF3

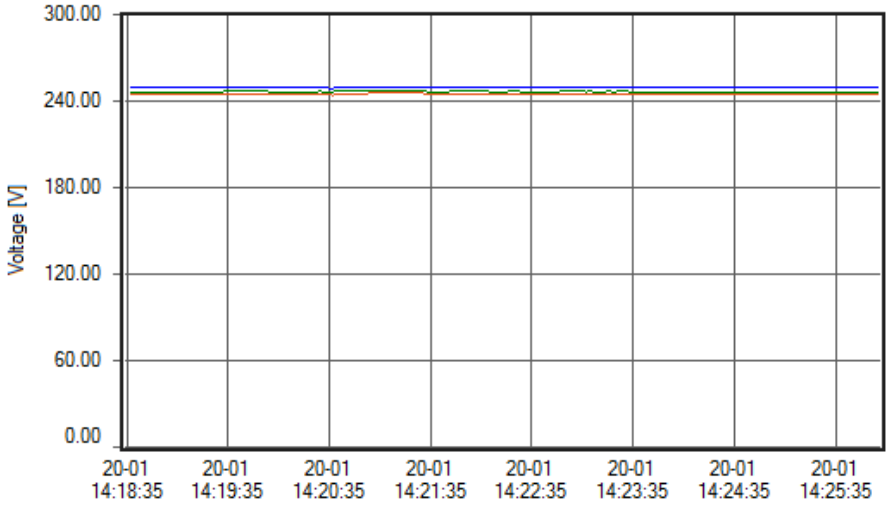
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

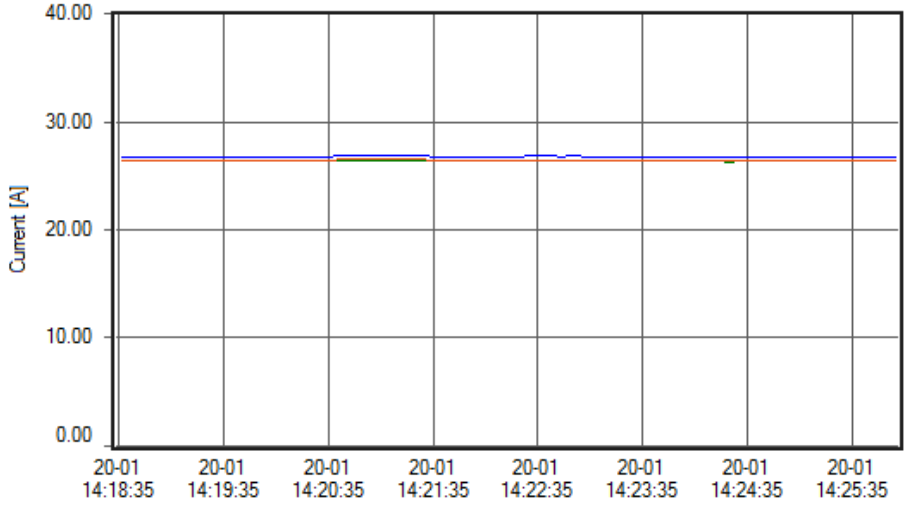
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:18:35 - 20-01-2020 14:26:02		
Display period	20-01-2020 14:18:35 - 20-01-2020 14:26:01		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-4 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
U1[V] U2[V] U3[V]

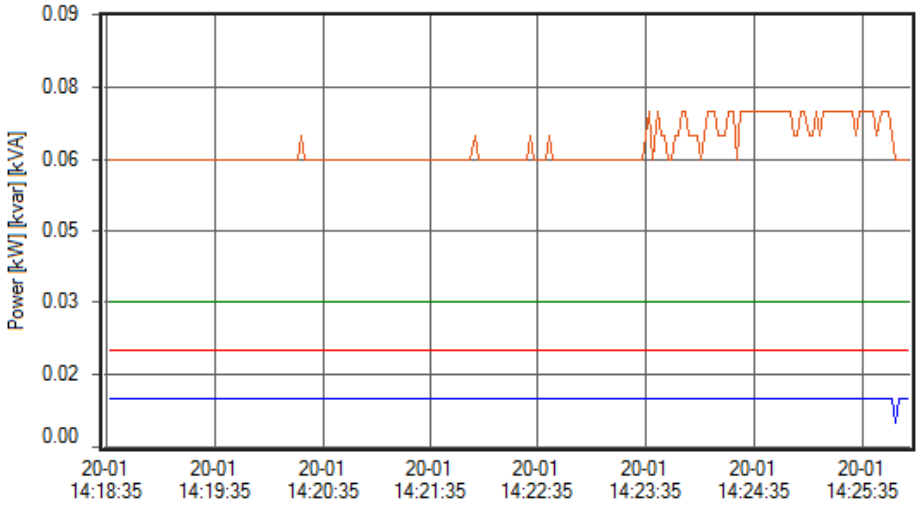


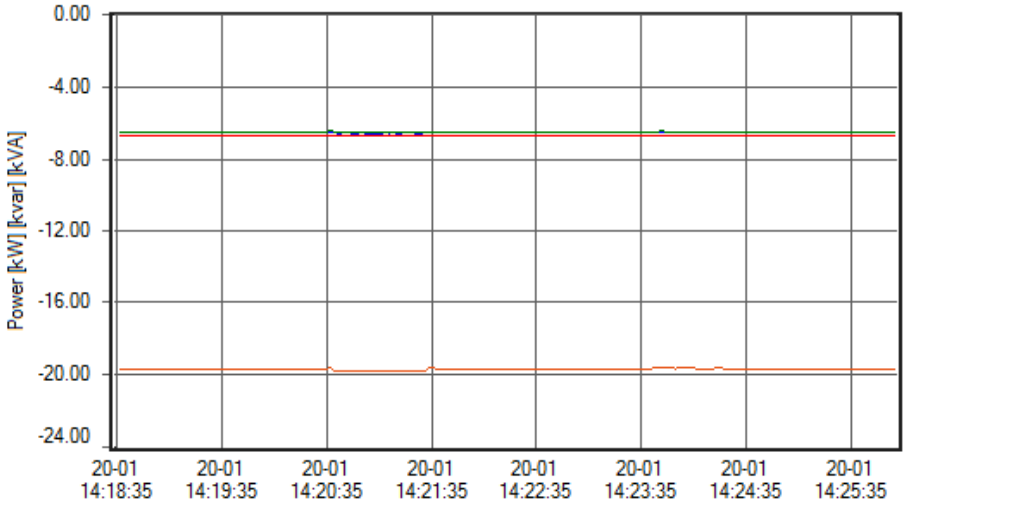
Left axis
I1[A] I2[A] I3[A]

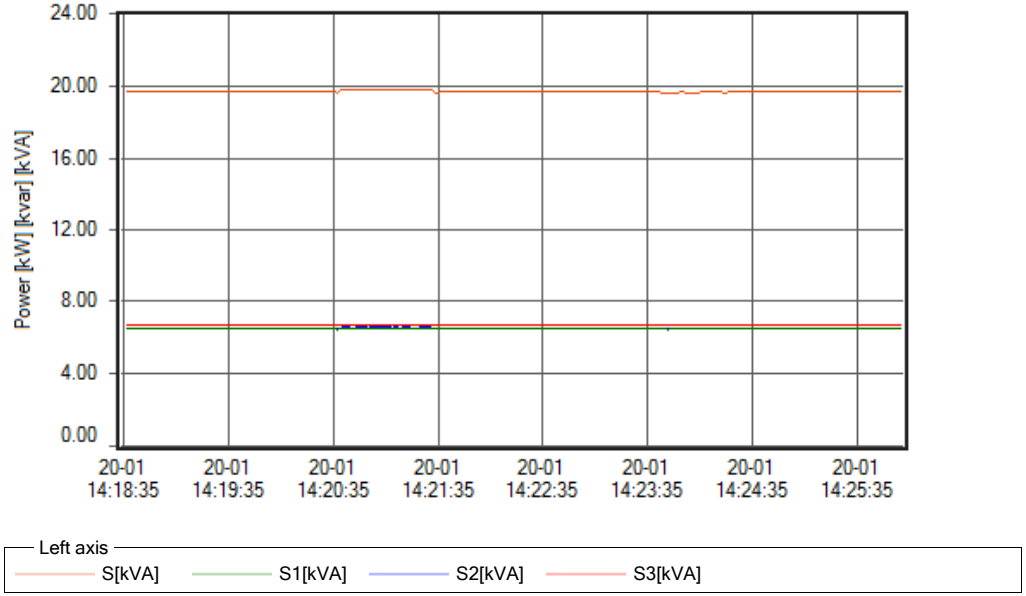
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

Title	KWA Thycattussery		
Measurement period	20-01-2020 14:18:35 - 20-01-2020 14:26:02		
Display period	20-01-2020 14:18:35 - 20-01-2020 14:26:01		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-4 (630kVA)		



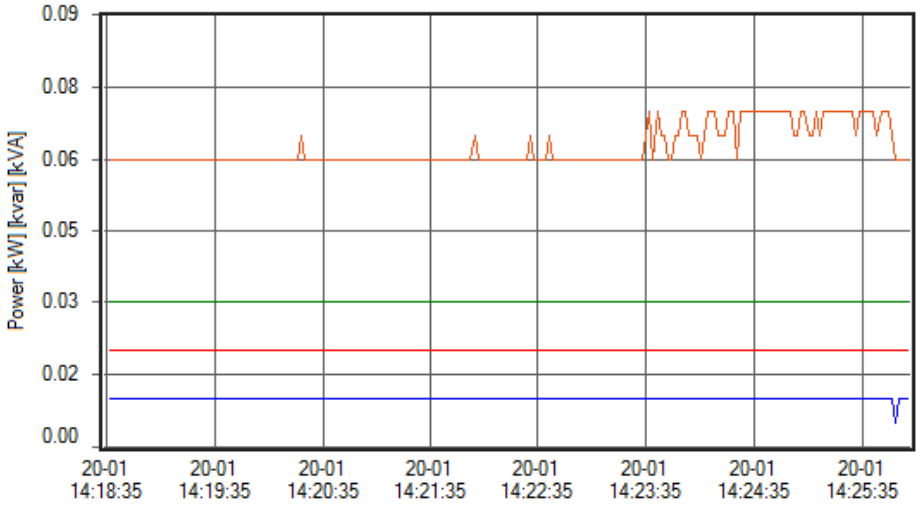




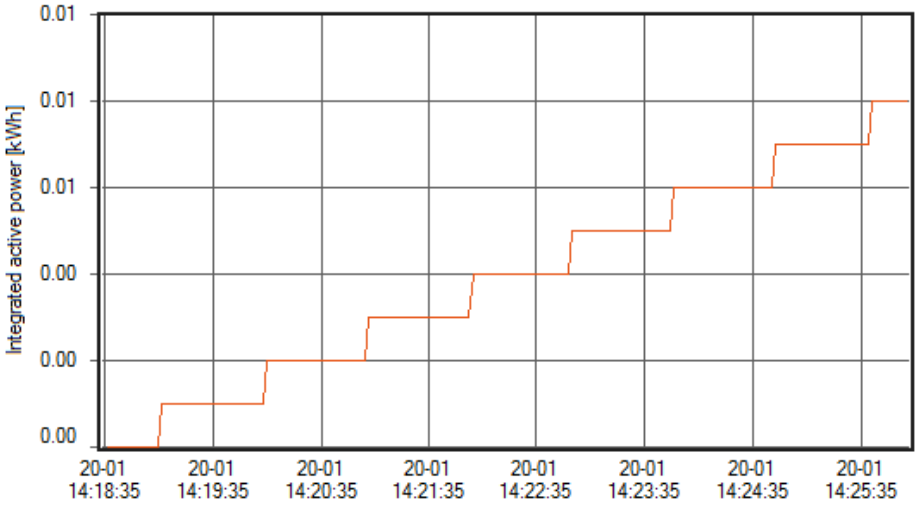
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

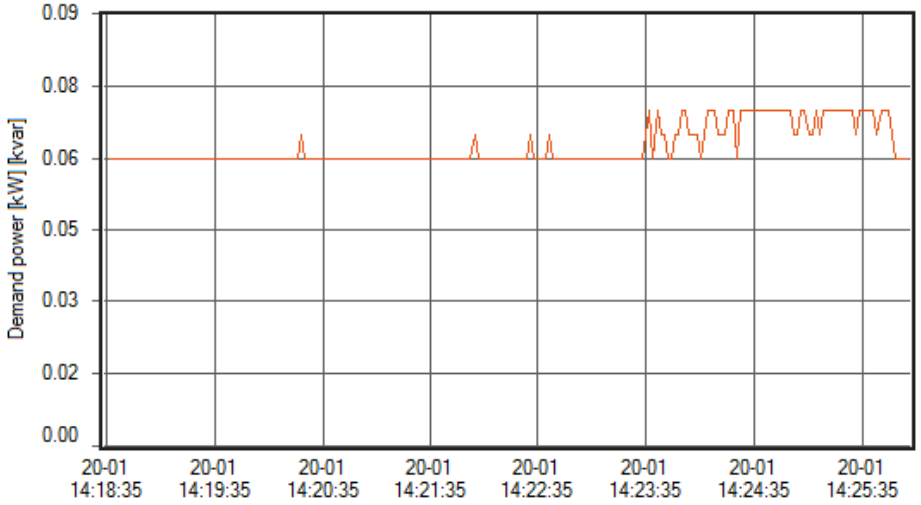
Title	KWA Thycattussery		
Measurement period	20-01-2020 14:18:35 - 20-01-2020 14:26:02		
Display period	20-01-2020 14:18:35 - 20-01-2020 14:26:01		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 Transformer-4 (630kVA)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
WP+[kWh]



Left axis
Pdem+[kW]

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

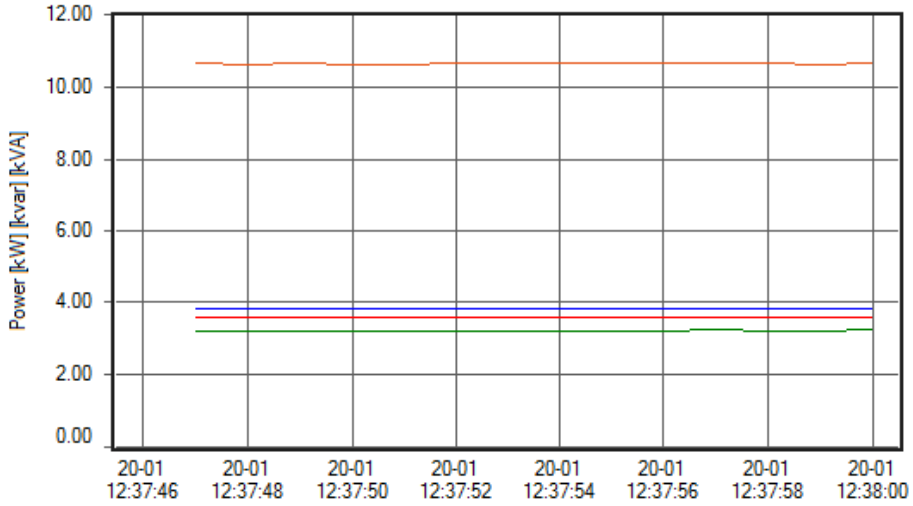
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Display period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1001 (15kW)		

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
Average value in the period		426.04	433.63	432.67	17.87	19.83	20.41	10.64	3.22	3.83	3.59	9.79	3.02
Maximum value in the period		426.27	433.78	432.83	17.89	19.85	20.43	10.64	3.23	3.83	3.59	9.80	3.02
Time of maximum value		20-01-2020 12:38:00	20-01-2020 12:38:00	20-01-2020 12:38:00	20-01-2020 12:37:57	20-01-2020 12:37:57	20-01-2020 12:37:52	20-01-2020 12:37:47	20-01-2020 12:37:57	20-01-2020 12:37:47	20-01-2020 12:37:47	20-01-2020 12:37:52	20-01-2020 12:37:47
Minimum value in the period		425.87	433.45	432.54	17.85	19.81	20.38	10.63	3.22	3.82	3.59	9.77	3.01
Time of minimum value		20-01-2020 12:37:51	20-01-2020 12:37:51	20-01-2020 12:37:51	20-01-2020 12:37:51	20-01-2020 12:37:50	20-01-2020 12:37:59	20-01-2020 12:37:48	20-01-2020 12:37:47	20-01-2020 12:37:49	20-01-2020 12:37:47	20-01-2020 12:37:51	20-01-2020 12:37:51
20-01-2020	12:37:46												
	12:37:47	425.95	433.49	432.59	17.87	19.82	20.41	10.64	3.22	3.83	3.59	9.78	3.02
	12:37:48	425.96	433.57	432.56	17.87	19.83	20.40	10.63	3.22	3.83	3.59	9.79	3.02
	12:37:49	426.03	433.61	432.71	17.86	19.82	20.41	10.64	3.22	3.82	3.59	9.79	3.02
	12:37:50	425.94	433.52	432.58	17.87	19.81	20.40	10.63	3.22	3.82	3.59	9.79	3.02
	12:37:51	425.87	433.45	432.54	17.85	19.81	20.40	10.63	3.22	3.82	3.59	9.77	3.01
	12:37:52	426.04	433.67	432.74	17.87	19.83	20.43	10.64	3.22	3.83	3.59	9.80	3.02
	12:37:53	425.97	433.60	432.66	17.87	19.83	20.42	10.64	3.22	3.83	3.59	9.79	3.02
	12:37:54	425.99	433.67	432.66	17.86	19.84	20.42	10.64	3.22	3.83	3.59	9.79	3.02
	12:37:55	426.00	433.66	432.66	17.86	19.84	20.42	10.64	3.22	3.83	3.59	9.80	3.02
	12:37:56	426.07	433.67	432.65	17.86	19.84	20.39	10.64	3.22	3.83	3.59	9.78	3.01
	12:37:57	426.16	433.71	432.69	17.89	19.85	20.40	10.64	3.23	3.83	3.59	9.80	3.02
	12:37:58	426.17	433.74	432.73	17.87	19.83	20.39	10.64	3.22	3.83	3.59	9.79	3.01
	12:37:59	426.18	433.67	432.72	17.89	19.82	20.38	10.63	3.22	3.82	3.59	9.80	3.02
	12:38:00	426.27	433.78	432.83	17.89	19.83	20.40	10.64	3.23	3.83	3.59	9.80	3.02

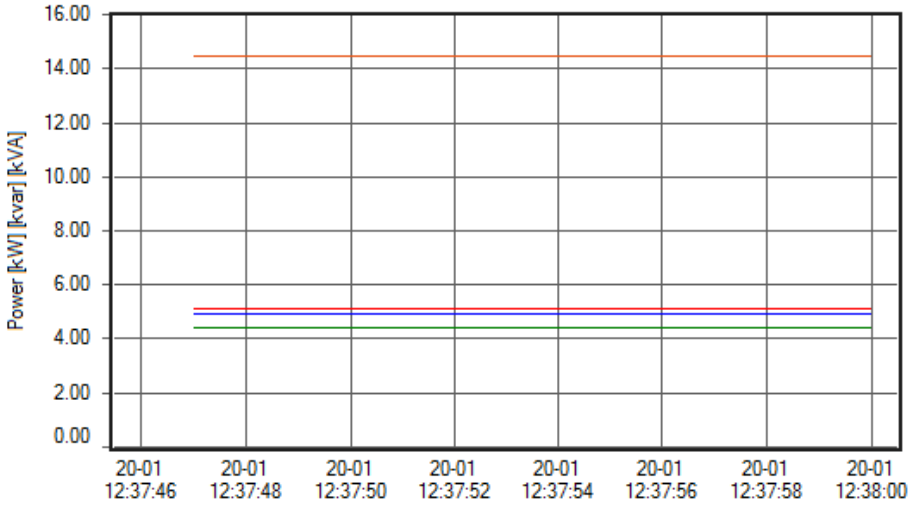
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

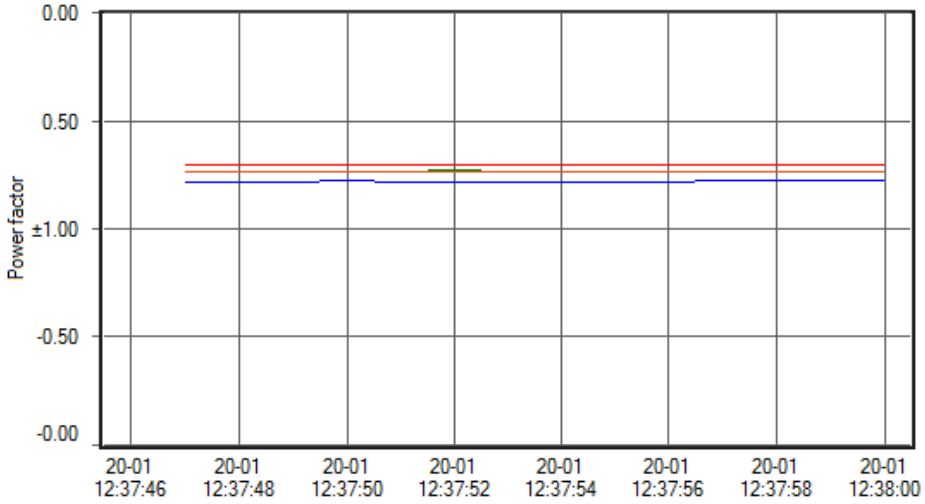
Title	KWA Thycattussery
Measurement period	20-01-2020 12:37:46 - 20-01-2020 12:38:00
Display period	20-01-2020 12:37:46 - 20-01-2020 12:38:00
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1001 (15kW)



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

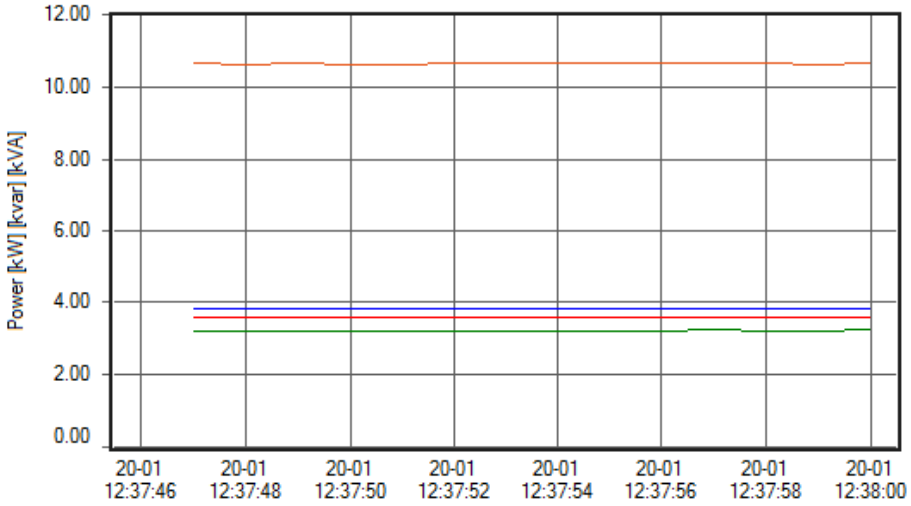


Left axis
PF PF1 PF2 PF3

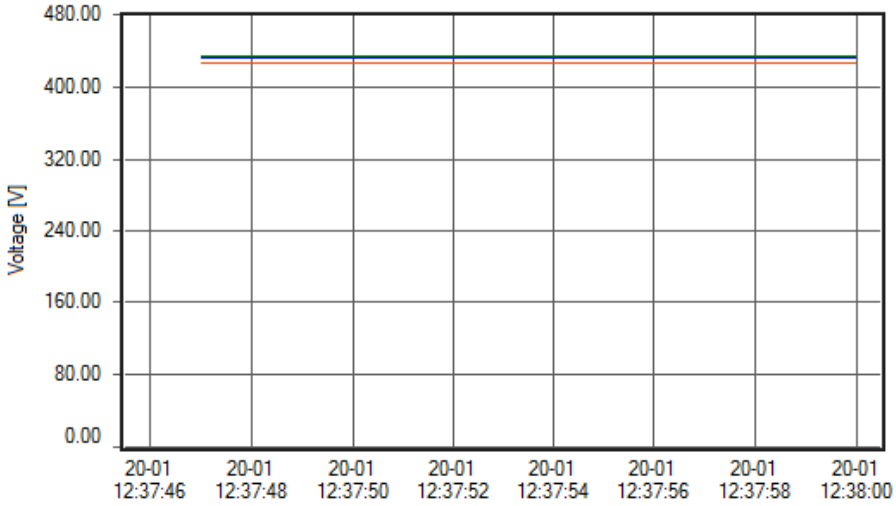
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

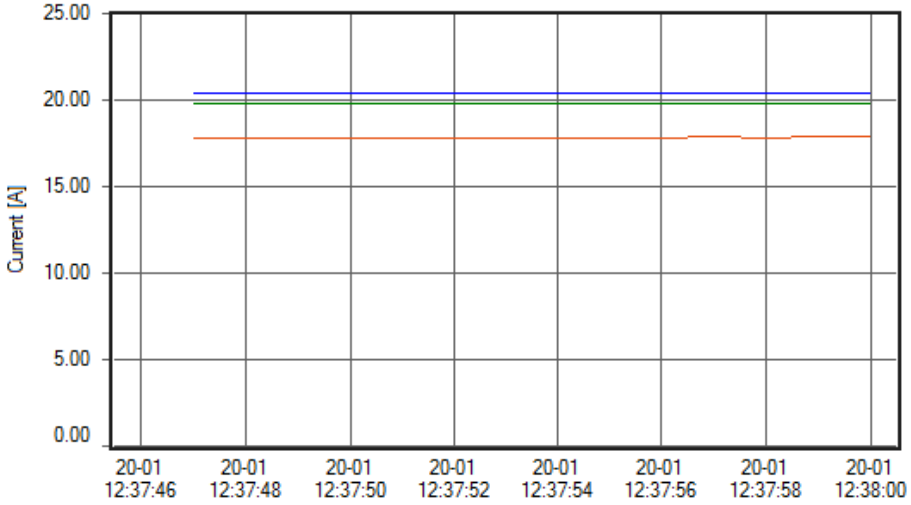
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Display period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1001 (15kW)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
U1[V] U2[V] U3[V]

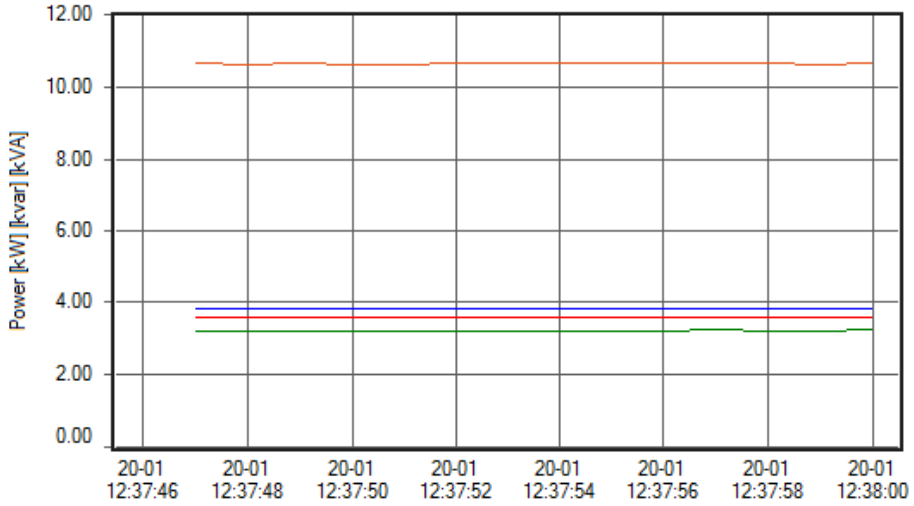


Left axis
I1[A] I2[A] I3[A]

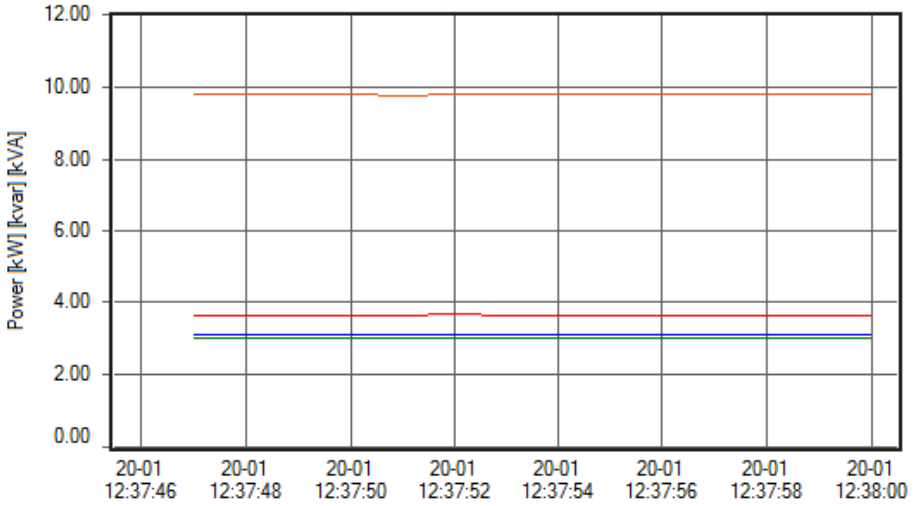
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

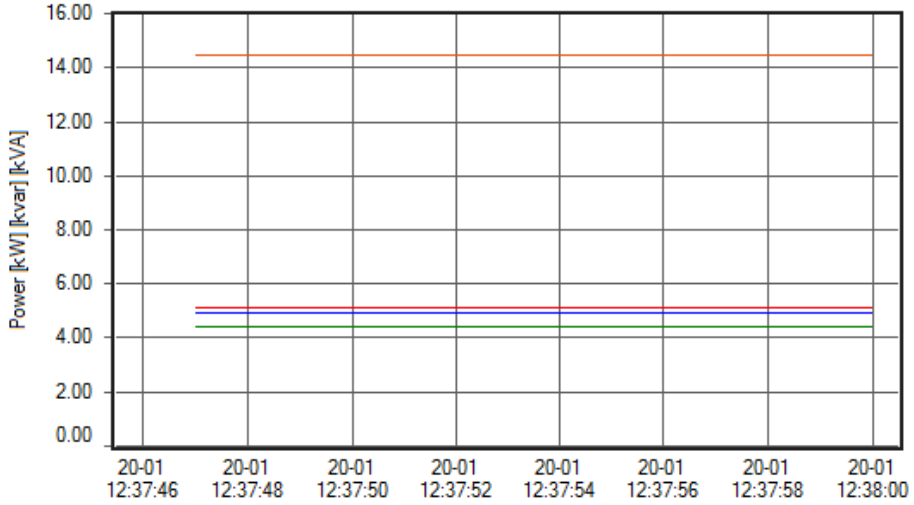
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Display period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1001 (15kW)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
Q[kvar] Q1[kvar] Q2[kvar] Q3[kvar]

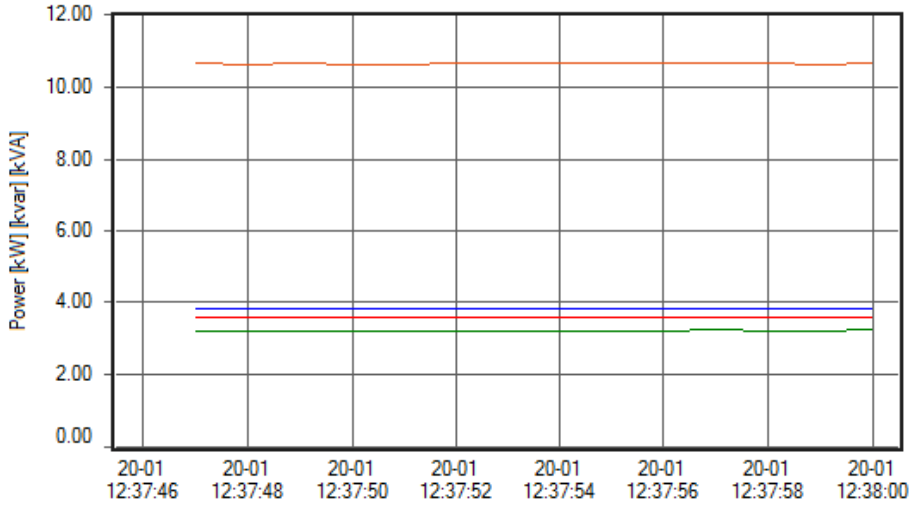


Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

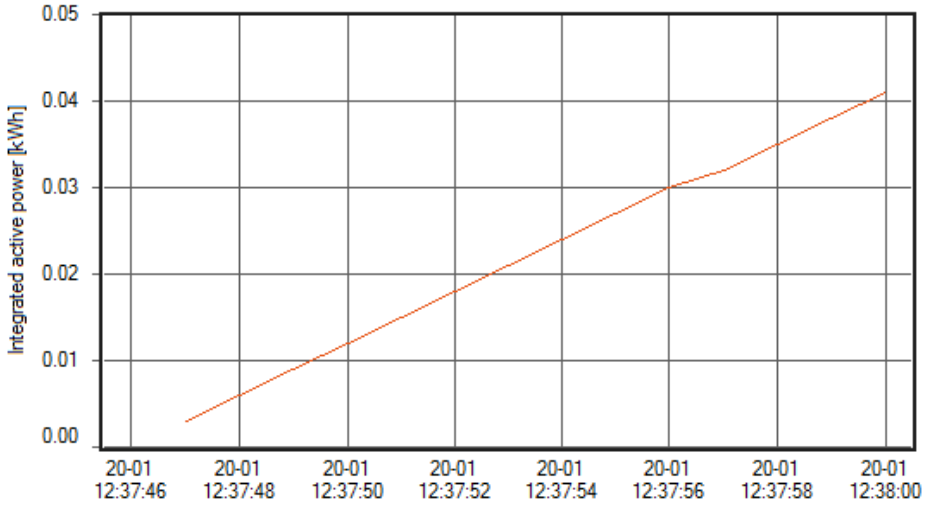
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

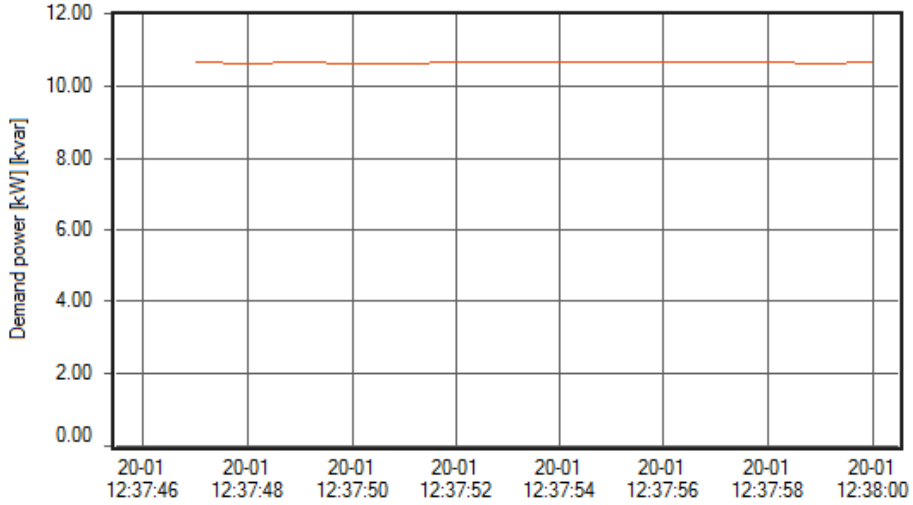
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Display period	20-01-2020 12:37:46 - 20-01-2020 12:38:00		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1001 (15kW)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
WP+[kWh]



Left axis
Pdem+[kW]

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

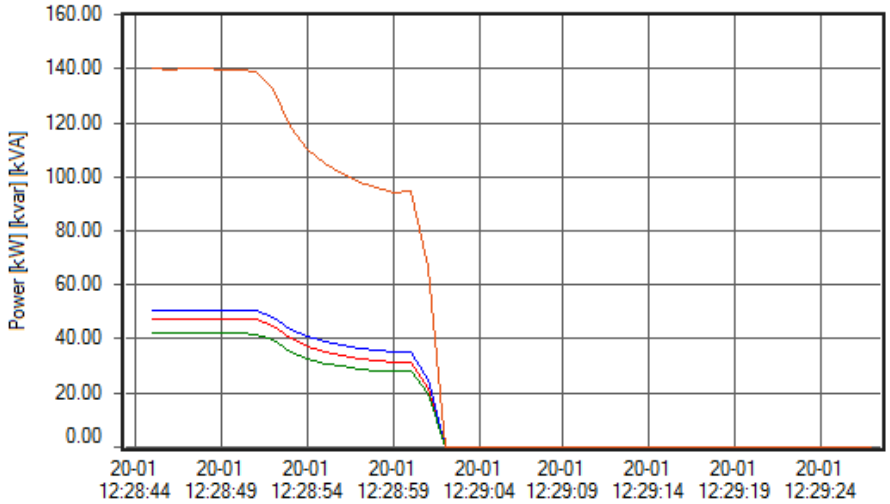
Title	KWA Thycattussery
Measurement period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Display period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1201 (180KkW)

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
Average value in the period		169.14	171.59	171.38	74.79	85.99	88.01	46.41	13.81	16.98	15.62	39.43	11.78
Maximum value in the period		420.96	427.28	426.84	216.54	247.07	252.05	139.95	42.03	50.62	47.34	106.12	31.83
Time of maximum value		20-01-2020 12:28:57	20-01-2020 12:28:46	20-01-2020 12:28:46	20-01-2020 12:28:48	20-01-2020 12:28:47	20-01-2020 12:28:45	20-01-2020 12:28:47	20-01-2020 12:28:49	20-01-2020 12:28:47	20-01-2020 12:28:45	20-01-2020 12:28:45	20-01-2020 12:28:45
Minimum value in the period		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time of minimum value		20-01-2020 12:29:05	20-01-2020 12:29:05	20-01-2020 12:29:05	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02	20-01-2020 12:29:02
20-01-2020	12:28:44												
	12:28:45	420.69	427.25	426.81	216.39	246.97	252.05	139.89	41.97	50.59	47.34	106.12	31.83
	12:28:46	420.71	427.28	426.84	216.00	246.60	251.69	139.73	41.91	50.54	47.29	105.90	31.76
	12:28:47	420.65	427.21	426.74	216.39	247.07	251.97	139.95	42.00	50.62	47.33	106.02	31.78
	12:28:48	420.68	427.24	426.74	216.54	247.07	251.95	139.95	42.02	50.60	47.33	106.08	31.82
	12:28:49	420.68	427.15	426.68	216.37	246.74	251.35	139.79	42.03	50.52	47.24	105.81	31.74
	12:28:50	420.52	427.04	426.58	216.46	247.03	251.84	139.85	42.00	50.57	47.29	106.00	31.78
	12:28:51	420.46	427.00	426.51	215.46	246.17	250.88	139.18	41.77	50.37	47.04	105.70	31.66
	12:28:52	420.50	427.11	426.52	206.74	237.28	242.11	132.26	39.52	48.10	44.64	104.10	31.10
	12:28:53	420.58	427.07	426.52	190.11	219.29	224.91	118.42	35.09	43.42	39.91	100.94	30.13
	12:28:54	420.64	427.04	426.46	180.32	208.62	214.46	110.22	32.51	40.64	37.07	98.81	29.46
	12:28:55	420.80	427.12	426.49	174.99	202.49	208.41	105.11	30.94	38.88	35.29	98.08	29.26
	12:28:56	420.94	427.15	426.51	170.42	197.46	203.22	101.10	29.73	37.51	33.86	97.07	28.93
	12:28:57	420.96	427.13	426.44	167.39	194.01	199.74	98.23	28.86	36.52	32.85	96.51	28.77
	12:28:58	420.92	426.99	426.28	165.80	192.14	197.66	96.51	28.37	35.93	32.21	96.25	28.69
	12:28:59	420.94	427.00	426.29	163.56	189.62	195.19	94.63	27.79	35.28	31.57	95.63	28.50
	12:29:00	420.91	426.88	426.15	164.17	190.05	195.35	94.72	27.88	35.27	31.56	95.91	28.61
	12:29:01	387.14	390.65	390.33	118.79	139.15	141.66	66.05	19.51	24.69	21.85	70.74	20.92
	12:29:02	114.39	114.35	114.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:03	31.10	31.27	31.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:04	8.60	8.62	8.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12:29:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

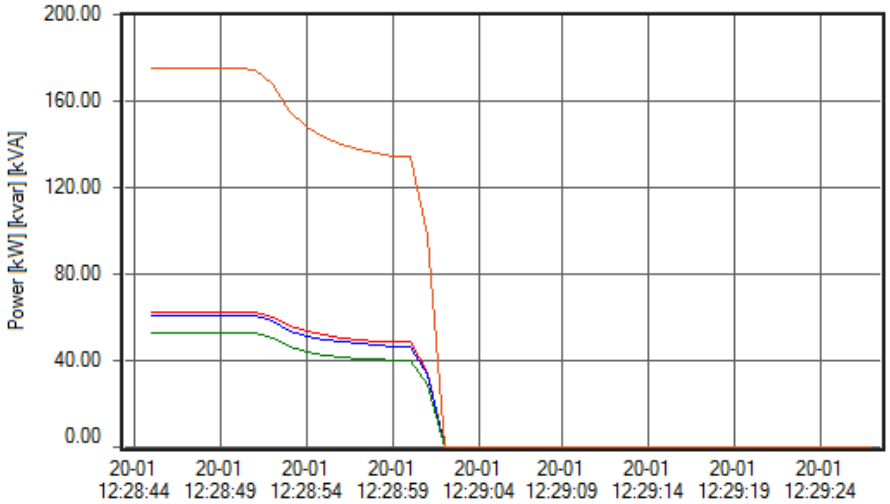
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

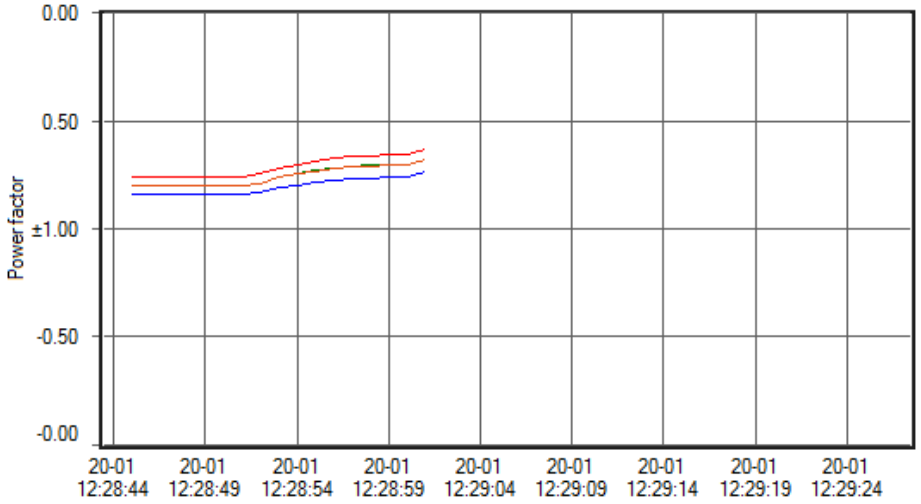
Title	KWA Thycattussery
Measurement period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Display period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1201 (180KkW)



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

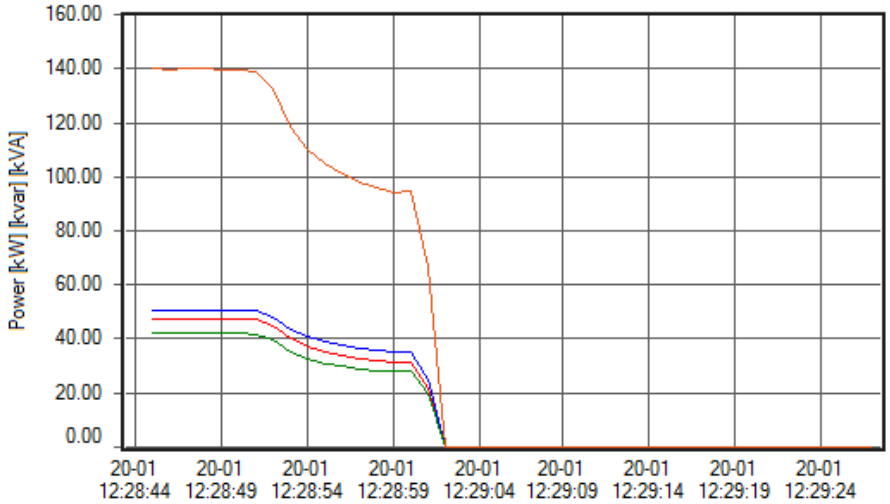


Left axis
PF PF1 PF2 PF3

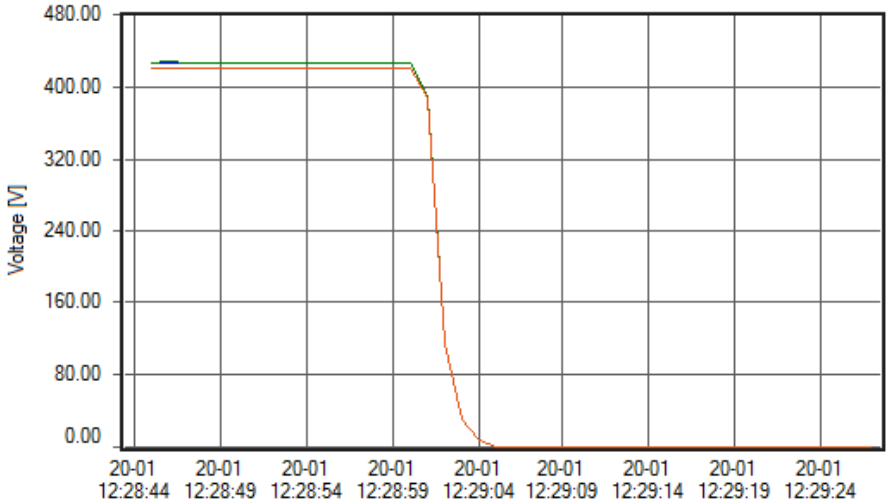
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

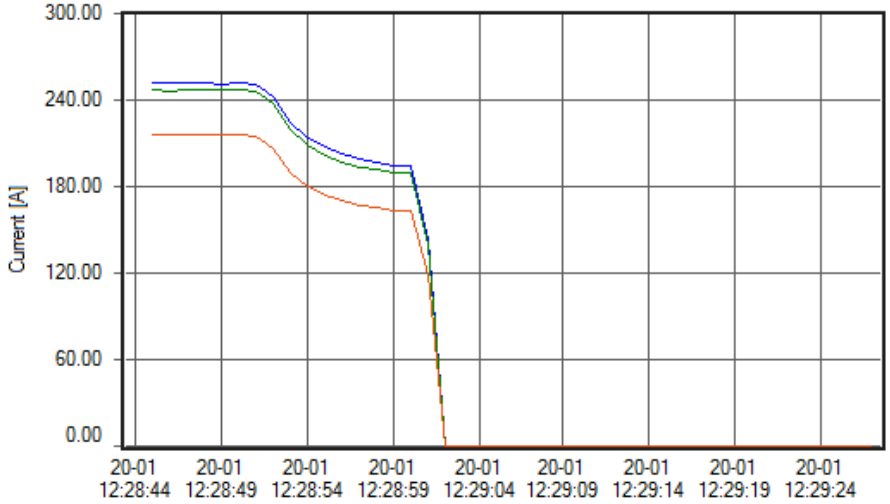
Title	KWA Thycattussery
Measurement period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Display period	20-01-2020 12:28:44 - 20-01-2020 12:29:27
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1201 (180KkW)



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
U1[V] U2[V] U3[V]

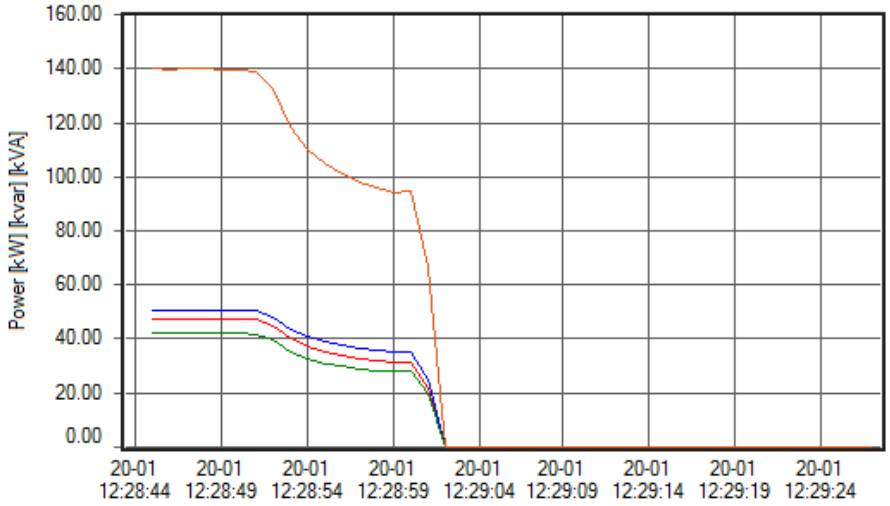


Left axis
I1[A] I2[A] I3[A]

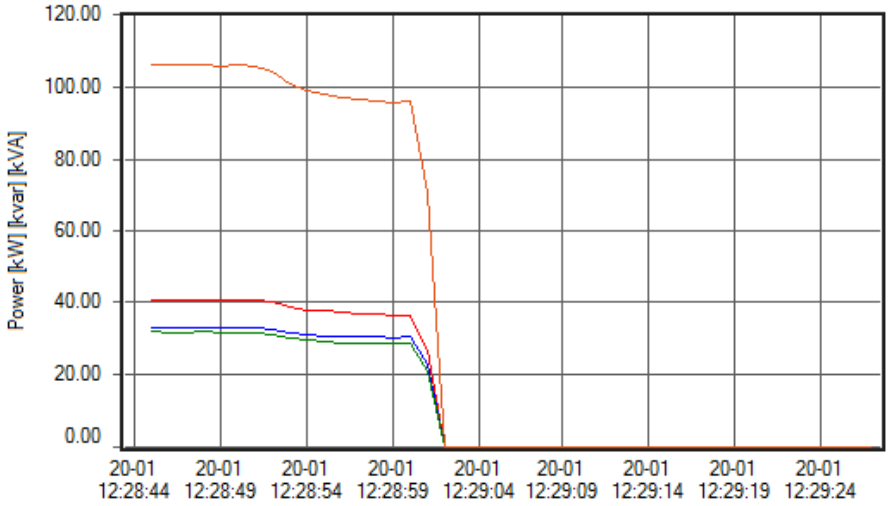
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

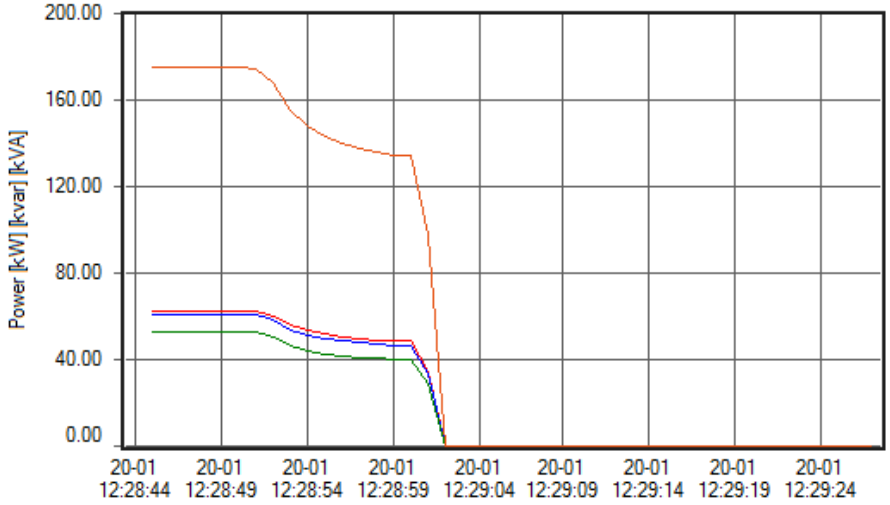
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:28:44 - 20-01-2020 12:29:27		
Display period	20-01-2020 12:28:44 - 20-01-2020 12:29:27		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1201 (180KkW)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
Q[kvar] Q1[kvar] Q2[kvar] Q3[kvar]

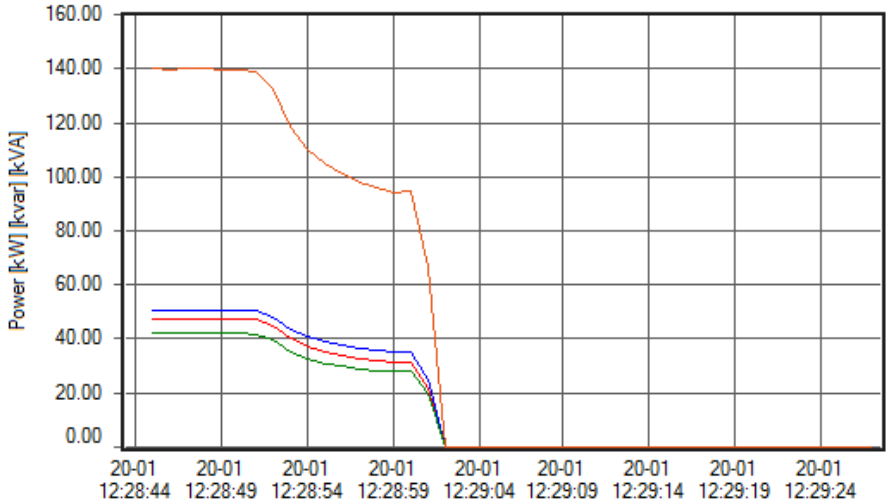


Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

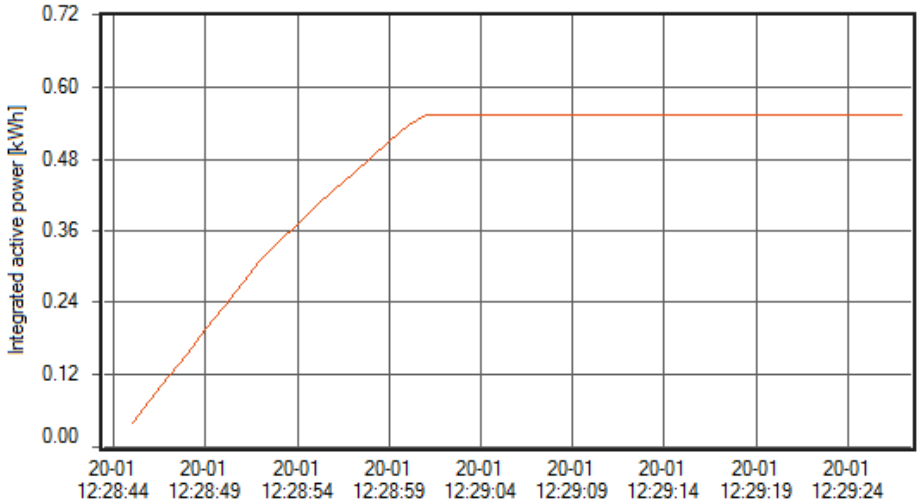
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

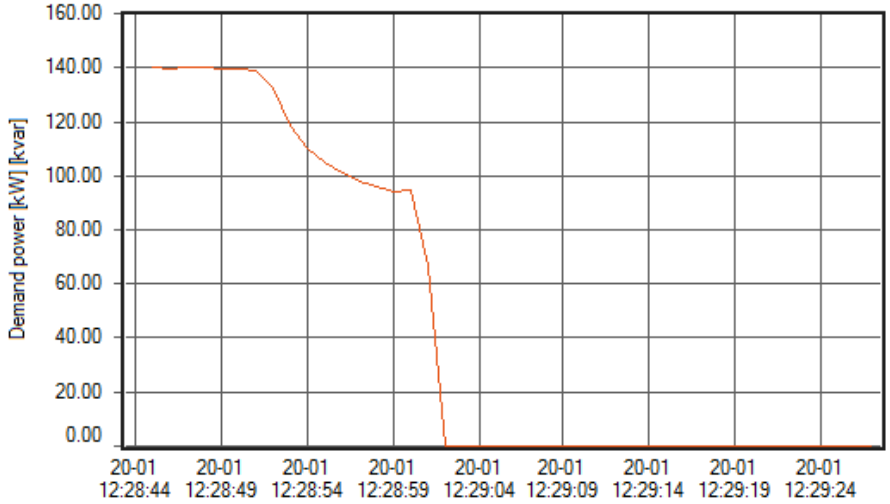
Title	KWA Thycattussery		
Measurement period	20-01-2020 12:28:44 - 20-01-2020 12:29:27		
Display period	20-01-2020 12:28:44 - 20-01-2020 12:29:27		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Motor 1201 (180KkW)		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]



Left axis
WP+[kWh]



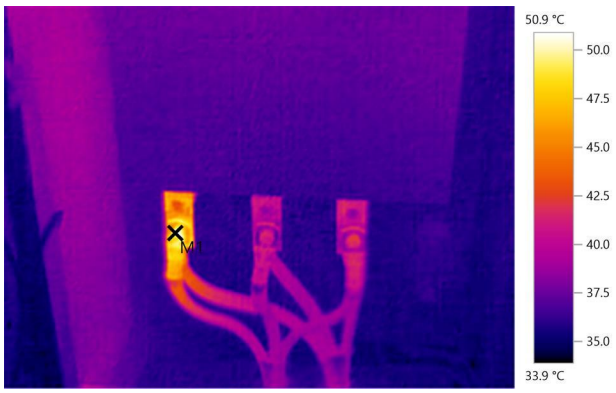
Left axis
Pdem+[kW]

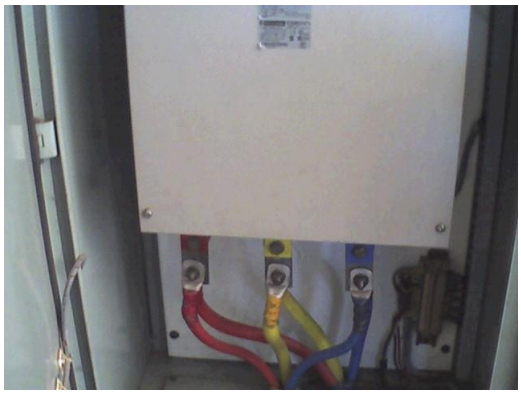
Thermography report

OTTOTRACTIONS
Energy Engineering Environment

Company	OTTOTRACTIONS ACCREDITED ENERGY AUDITOR BUREAU OF ENERGY EFFICIENCY	**Customer**	KWA Thycattusserry
Tester	Abin		

Device	testo 875-1i	Serial No.:	2621731	Lens:	Standard 32°
Task	Energy audit				





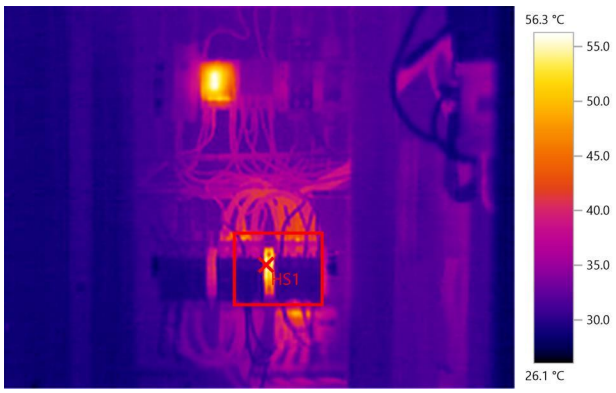
Picture data:	**Date:**	20-01-2020	**Emissivity:**	0.95
	Measuring Time:	11:51:29	**Refl. temp. [°C]:**	20.0
	File:	M-701.BMT		

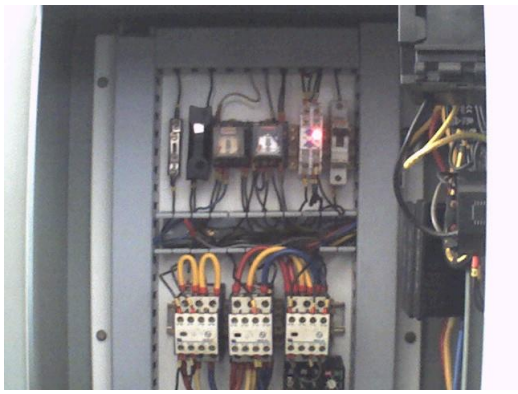
Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	50.7	0.95	20.0	-

Remarks: Loose connection at R-Phase

Thermography report

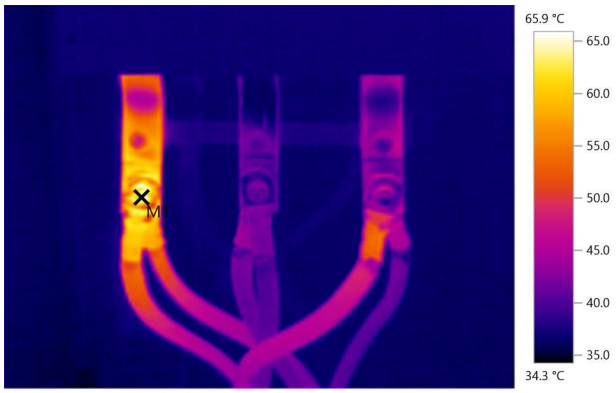


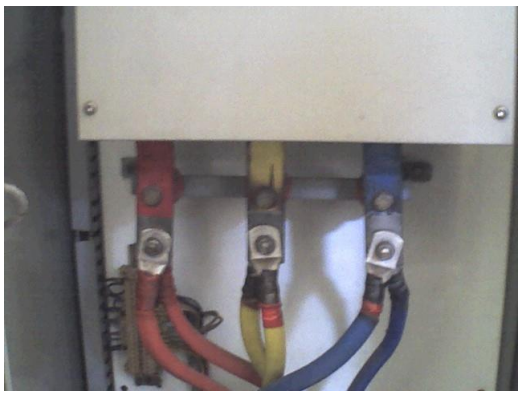


Picture data:	**Date:**	20-01-2020	**Emissivity:**	0.95
	Measuring Time:	12:37:28	**Refl. temp. [°C]:**	20.0
	File:	TWSP-M-1001.BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Hot spot 1	56.3	0.95	20.0	-





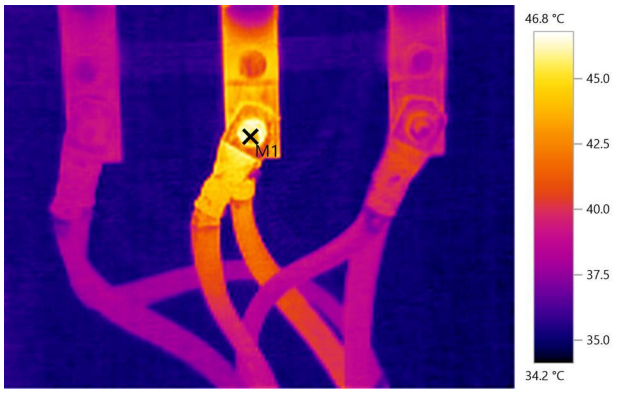
Picture data:	**Date:**	20-01-2020	**Emissivity:**	0.95
	Measuring Time:	12:38:57	**Refl. temp. [°C]:**	20.0
	File:	TWSP-M-1101.BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	62.6	0.95	20.0	-

Thermography report

Remarks: Loose connection at R-phase



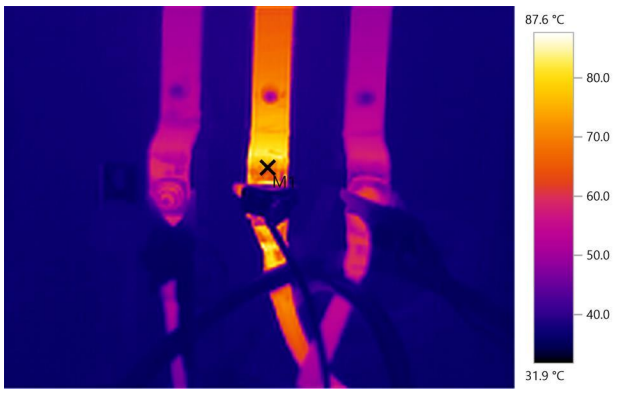
Picture data:	**Date:**	20-01-2020	**Emissivity:**	0.95
	Measuring Time:	12:22:58	**Refl. temp. [°C]:**	20.0
	File:	TWSP-M-1201.BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	44.2	0.95	20.0	-

Remarks: Loose connection at Y-phase

Thermography report

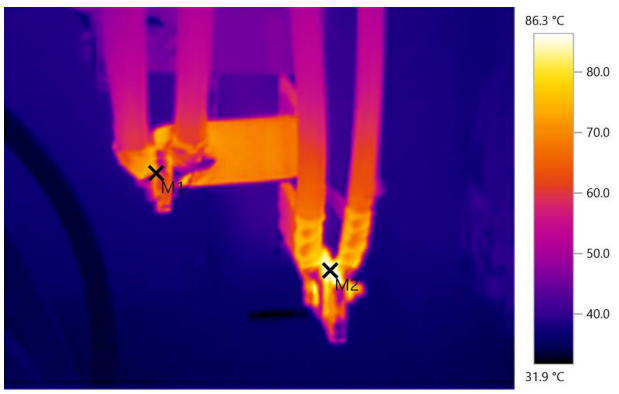


Picture data:	**Date:**	20-01-2020	**Emissivity:**	0.95
	Measuring Time:	12:22:23	**Refl. temp. [°C]:**	20.0
	File:	WW-P-M201.BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	66.2	0.95	20.0	-

Remarks: Terminal loose at B-Phase

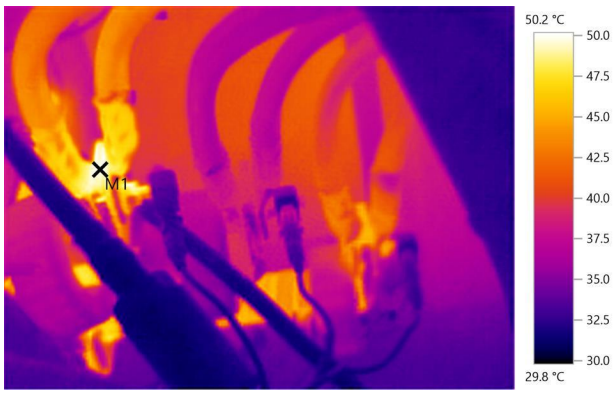


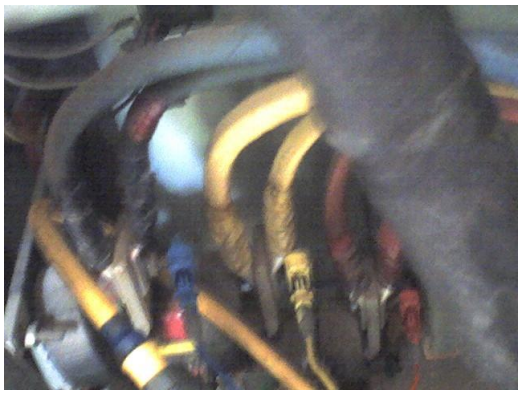
Picture data:	**Date:**	21-01-2020	**Emissivity:**	0.95
	Measuring Time:	11:11:29	**Refl. temp. [°C]:**	20.0
	File:	APFC 150kVAR.BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	70.3	0.95	20.0	-
Measure point 2	84.9	0.95	20.0	-

Remarks: Terminal loose at R and Y phase





Picture data:	**Date:**	21-01-2020	**Emissivity:**	0.95
	Measuring Time:	11:10:50	**Refl. temp. [°C]:**	20.0
	File:	APFC 300kVAR.BMT		

Picture markings:

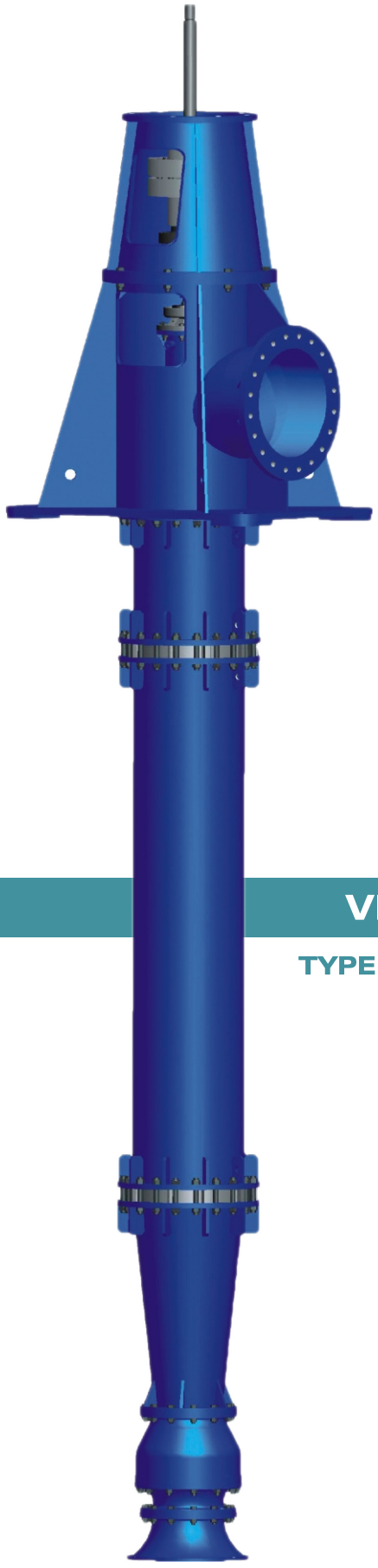
Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	49.7	0.95	20.0	-

Remarks: Terminal loose at B-phase

02-11-2020 ,

Abin

Enriching Lives



VERTICAL PUMPS

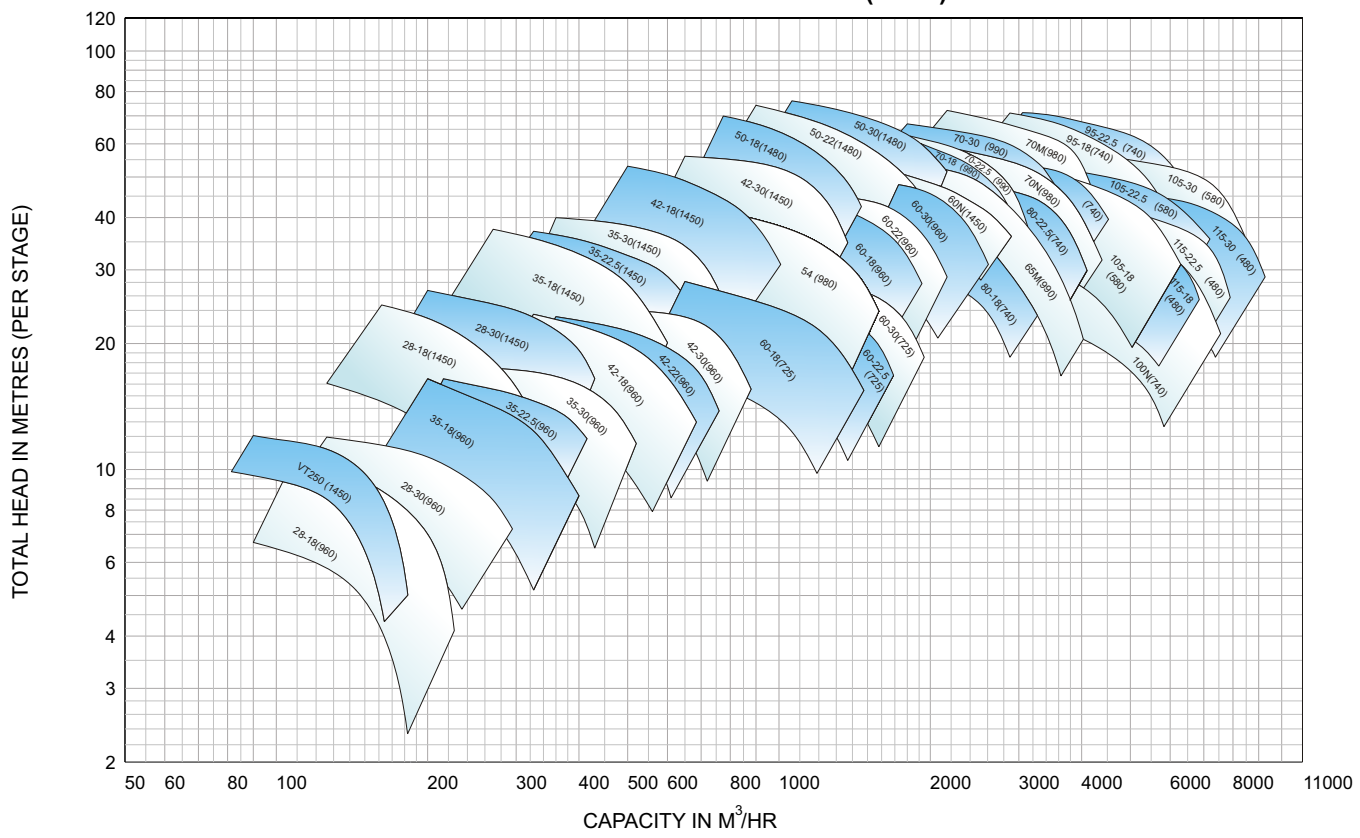
TYPE - BHR / BHQ / BHM / BHK / BHMa / BHA

CE Ex

KIRLOSKAR BROTHERS LIMITED

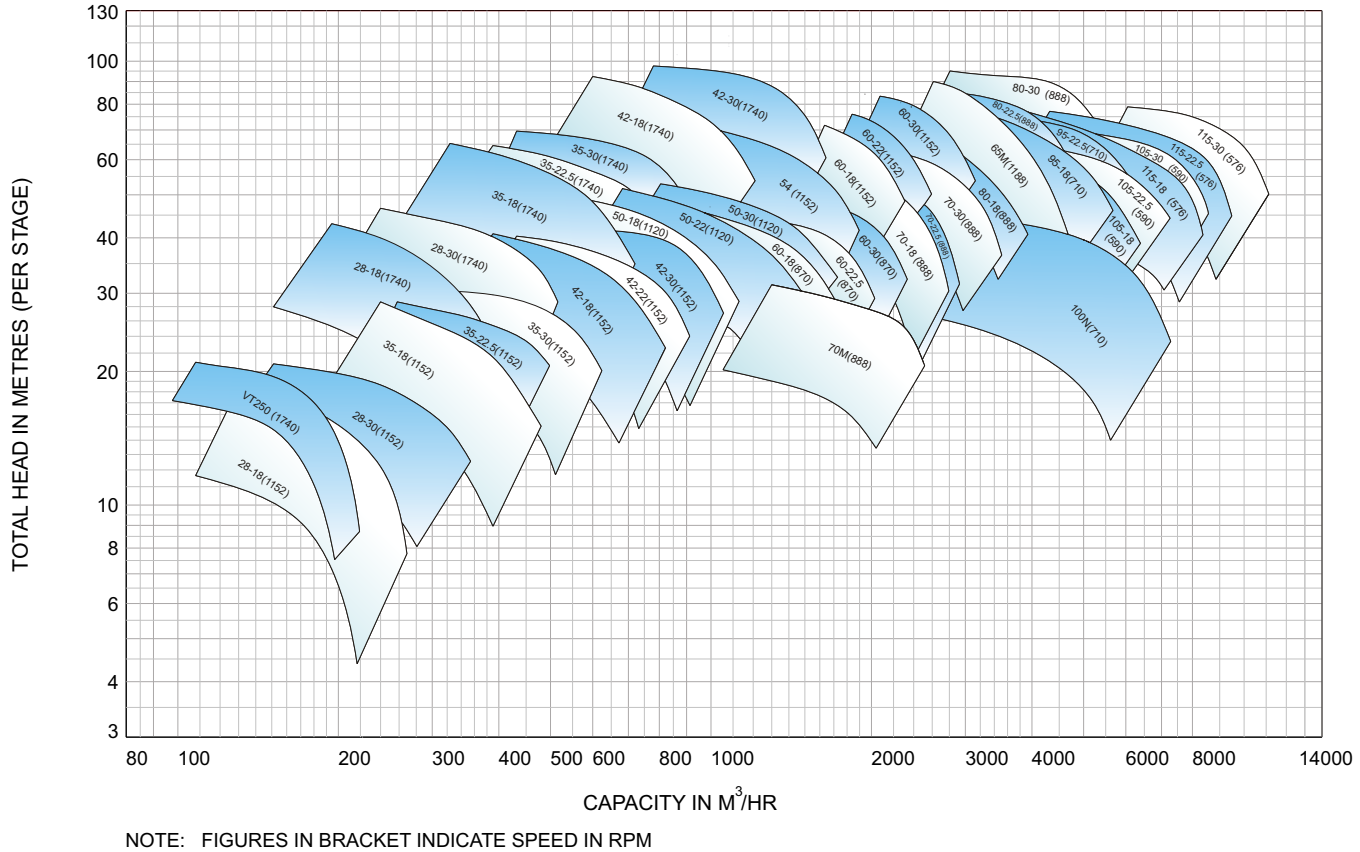
A Kirloskar Group Company

FAMILY CURVES FOR BHR PUMPS (50HZ)



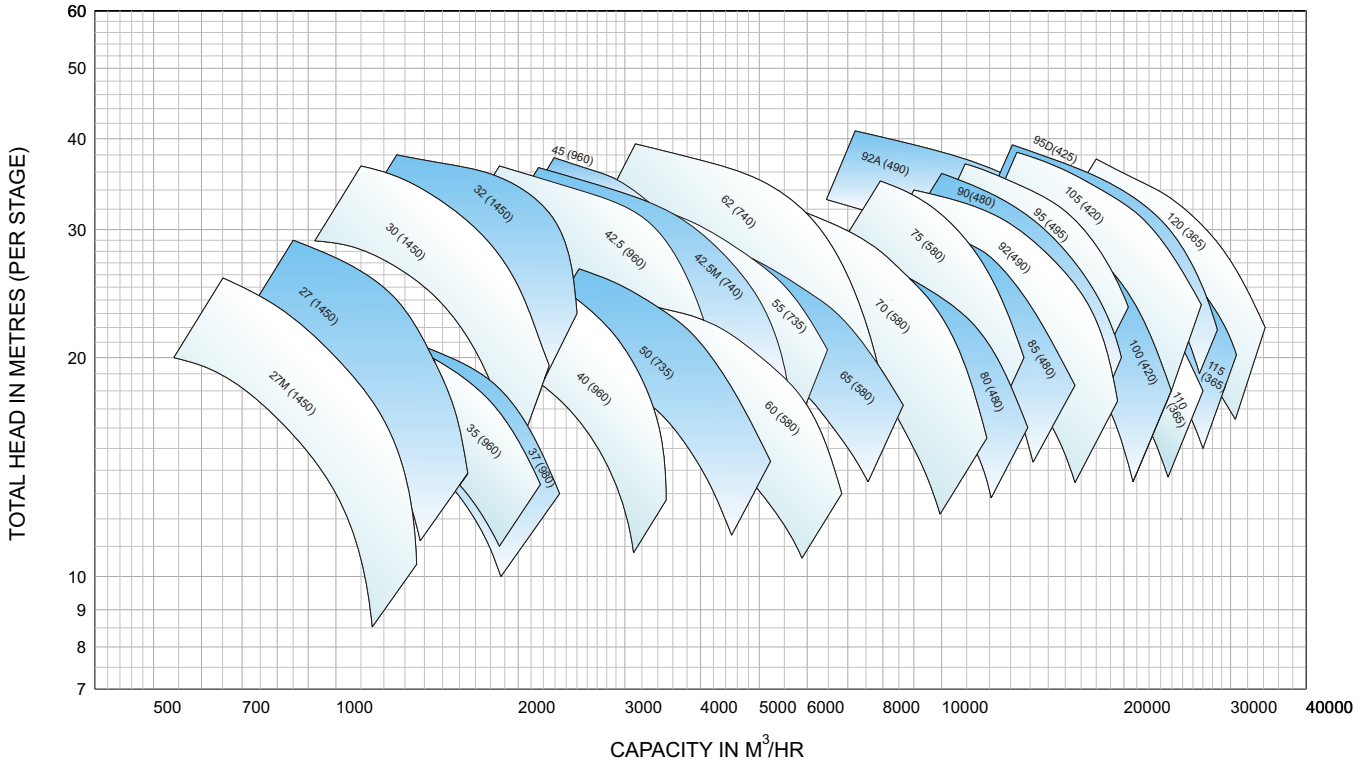
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHR PUMPS (60HZ)



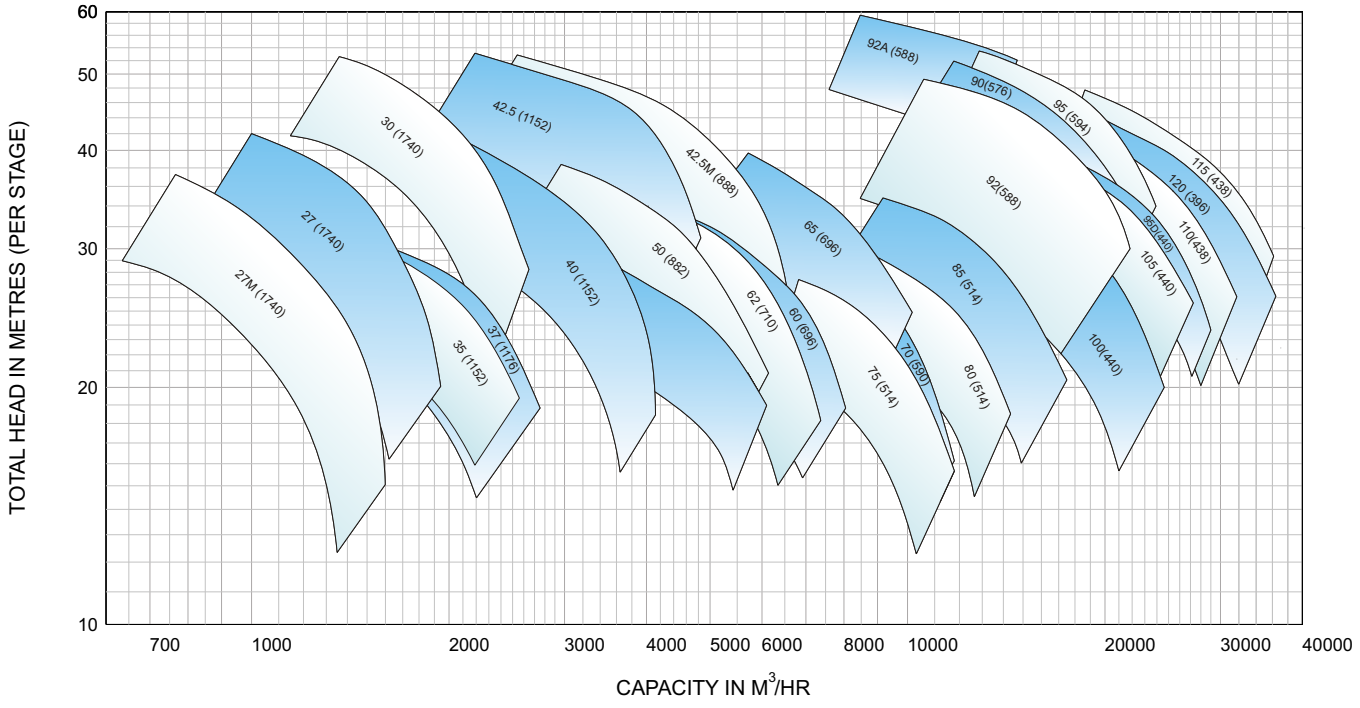
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (50HZ)



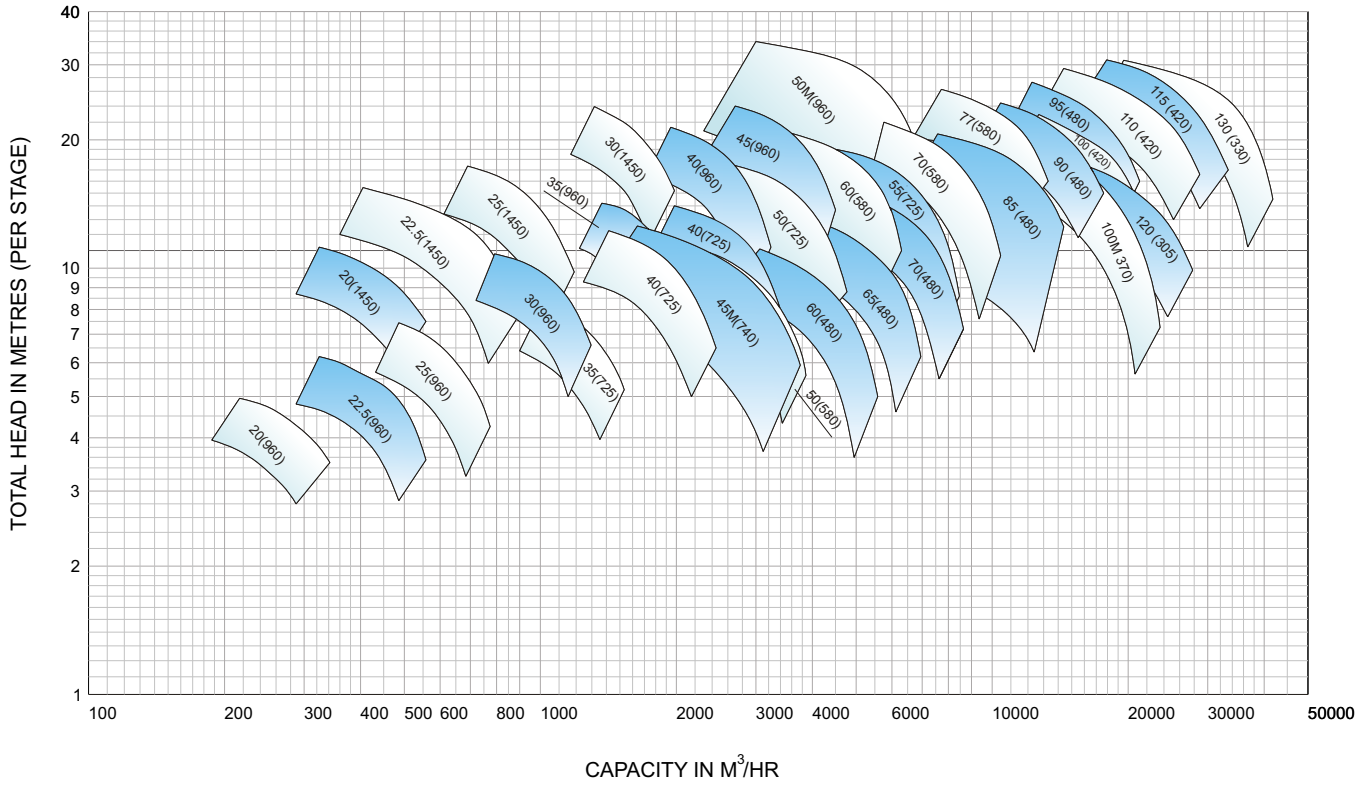
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (60HZ)



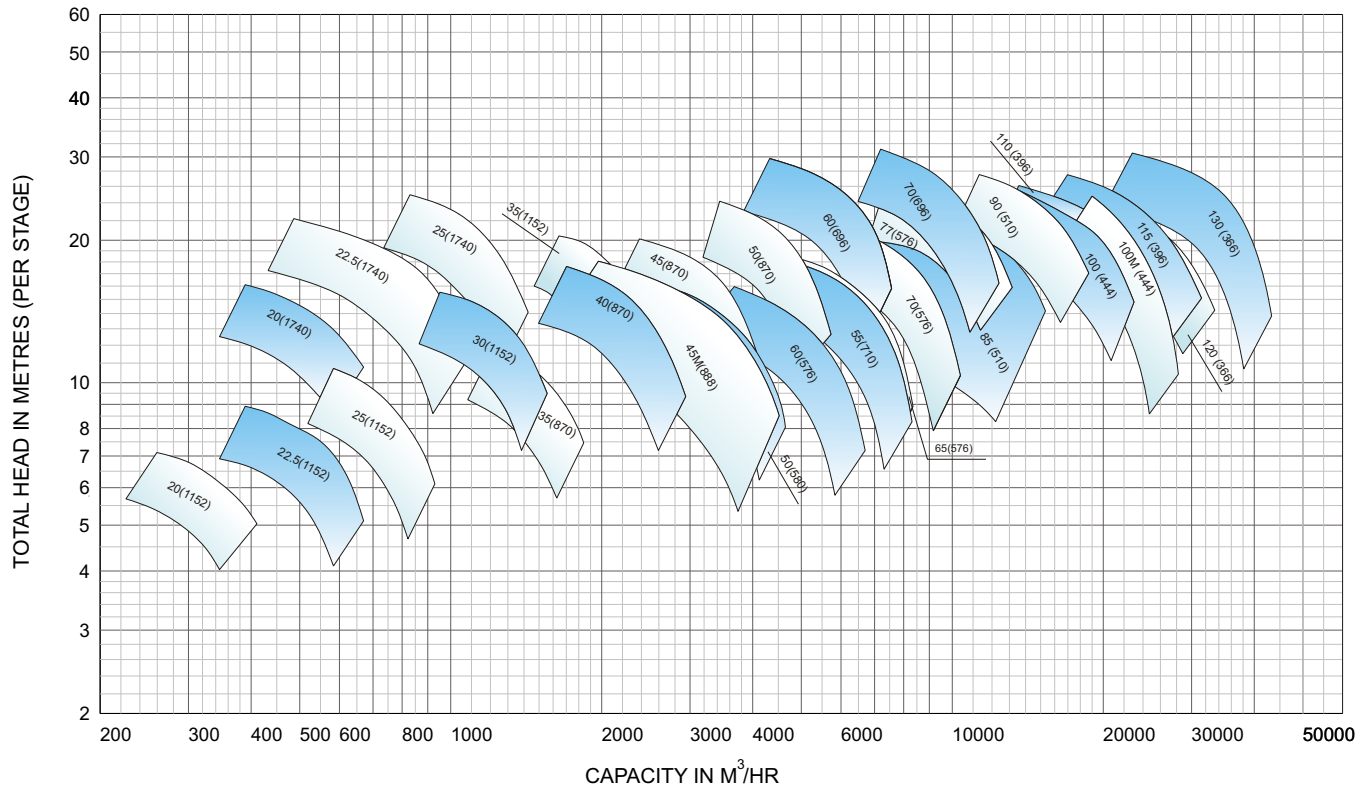
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (50HZ)



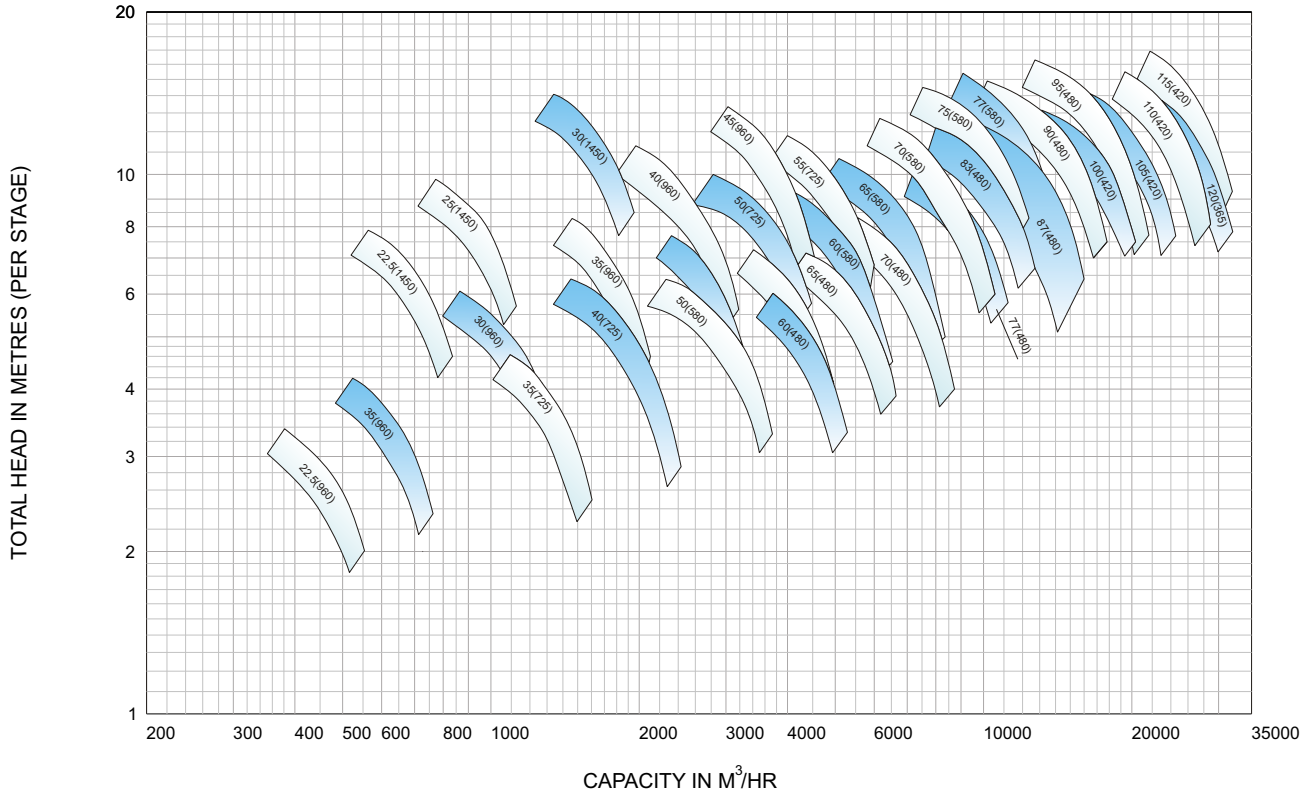
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (60HZ)



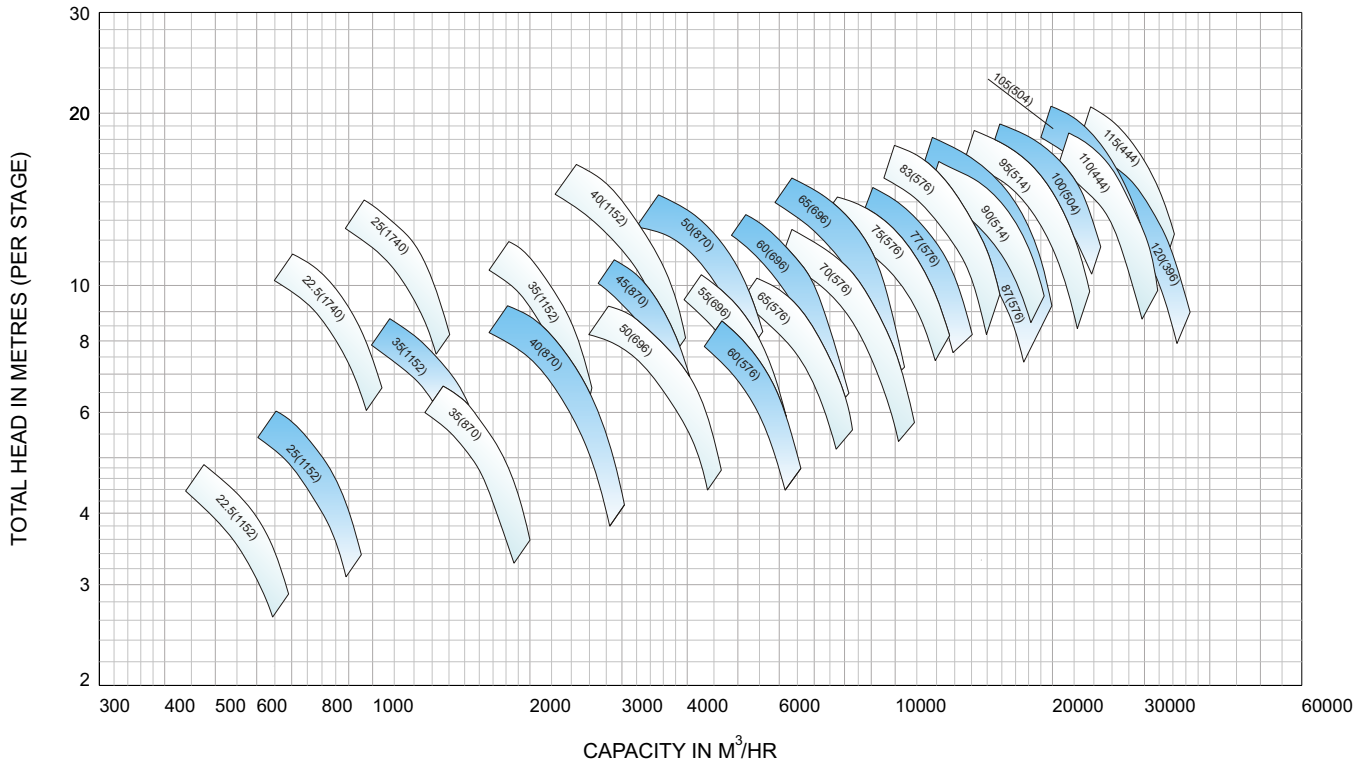
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHMa PUMPS (50HZ)



NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHMa PUMPS (60HZ)



NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

ABOUT KBL

Kirloskar Brothers Limited (KBL) is a world class pump manufacturing company with expertise in engineering and manufacture of systems for fluid management. Established in 1888 and incorporated in 1920, KBL is the flagship company of the $ 2.1 billion Kirloskar Group. KBL, a market leader, provides complete fluid management solutions for large infrastructure projects in the areas of water supply, power plants, irrigation, oil & gas and marine & defence. We engineer and manufacture industrial, agriculture and domestic pumps, valves and hydro turbines.

In 2003, KBL acquired SPP Pumps, United Kingdom and established SPP INC, Atlanta, USA, as a wholly owned subsidiary of SPP, UK to expand its international presence. In 2007, Kirloskar Brothers International B.V., The Netherlands and Kirloskar Brothers (Thailand) Ltd., a wholly owned subsidiary in Thailand, were incorporated. In 2008, KBL incorporated Kirloskar Brothers Europe B.V. (Kirloskar Pompen B.V. since June 2014), a joint venture between Kirloskar International B.V. and Industrial Pump Group, The Netherlands. In 2010, KBL further consolidated its global position by acquiring Braybar Pumps, South Africa. SPP MENA was established in Egypt in 2012. In 2014, KBL acquired SyncroFlo Inc., the largest independent fabricator of commercial and municipal domestic water booster pumps.

To further strengthen its global position, in 2015, Kirloskar Pompen B.V. acquired Rodelta Pumps International, The Netherlands.

KBL has joint venture cooperation with Ebara, Japan since 1988 for the manufacture of API 610 standard pumps. Kirloskar Corrocoat Private Limited is a joint venture cooperation with Corrocoat, UK since 2006. KBL acquired The Kolhapur Steel Limited in 2007 and Hematic Motors in 2010.

KBL has eight manufacturing facilities in India at Kirloskarvadi, Dewas, Kondhapuri, Shirwal, Sanand, Kaniyur, Kolhapur and Karad. In addition, KBL has global manufacturing and packaging facilities in Egypt, South Africa, Thailand, The Netherlands, United Arab Emirates, United Kingdom and United States of America. KBL has 12,700 channel partners in India and 80 overseas and is supported by best-in-class network of Authorised Centres and Authorised Refurbishment Centres across the country.

All the manufacturing facilities at KBL are certified for ISO 9001, ISO 14001, ISO 50001, BS OHSAS 18001 and SA8000. In addition, the Kirloskarvadi plant is also certified for N & NPT Stamp. KBL's corporate office in Pune is certified for ISO 9001 & Sa8000.

The factories deploy Total Quality Management tools using European Foundation for Quality Management (EFQM) model.
The Kirloskarvadi plant of KBL is a state-of-the-art integrated manufacturing facility having Asia's largest hydraulic research centre with testing facility upto 5000 kW and 50,000 m^3/hr.

KBL is the ninth pump manufacturing company in the world to be accredited with the N and NPT certification by American Society of Mechanical Engineers (ASME).

Pumps | Valves | Hydro Turbines | Turnkey Projects

Water Resource Management | Irrigation | Power | Industry | Oil & Gas | Marine & Defence | Building & Construction| |
Distribution (Small Pumps) | Valves | Customer Service & Spares

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KIRLOSKAR BROTHERS LIMITED

A Kirloskar Group Company

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Email: marketing@kbl.co.in, Website: www.kirloskarpumps.com, CIN No.: L29113PN1920PLC000670

OUR COMPANIES

United Kingdom | U.S.A. | South Africa | India | The Netherlands

VT-BHR-BHQ - 06-2016

Jyoti Ltd.

Water • Power • Progress

JYOTI
Vertical Turbine Pumps
(oil & water-lubricated)

Manufactured, designed
and made the First Vertical Turbine
(VT) Pump in India, way back in 1942

ISO 9001:2015 || TUV INDIA

TÜV INDIA
TÜV NORD GROUP

70 YEARS OF ENGINEERING EXCELLENCE

APPLICATION

Pumps for

- irrigation
- urban & rural water supply
- Cooling tower
- Fire fighting
- Flood control
- Mine dewatering
- Thermal power stations
- Condensate extraction
- General & process water in industries
- Oil field water services and a hoast of other needs.

RANGE

Bowl sizes	150 mm to 600 mm
Capacity	200 lpm to 33200 lpm
Head	upto 225 mts

For higher capacities refer to us.

SPECIAL DESIGN FEATURES

- Heavy wall cast iron bowls & cast iron / Stainless Steel impellers provided for maximum operating life, under ardous Indian conditions.
- Impeller shafts of stainless steel
- Column pipes and line shafts are machined and threaded on double ended special purpose machines in single setting ensuring concentricity.
- All shaft couplings in water lubricated pumps are made of stainless steel for extra-long life.

CONSTRUCTIONAL FEATURES

'JYOTI' VT pumps are offered in non-pull out construction as a standard design. The pump can be supplied for coupling with vertical hollow shaft motors or vertical solid shaft motors. Also for surface discharge or underground discharge.

BOWLS

Standard bowls are made of close grained cast iron. The diffuser vanes are cast integrally.

IMPELLERS

Impellers are closed or semi-open type, statically and dynamically balanced for vibration-free operation. They are secured to the impeller shaft with tapered lock collects or keys & split rings. The impeller position can be adjusted vertically by means of impeller-adjusting nut provided in the drive.

IMPELLER SHAFT

Impeller shaft is of stainless steel, accurately ground to close tolerances. The shaft is supported by bearings above and below each impeller.

COLUMN PIPES

Column pipes are normally supplied in nominal lengths of 3.0m, 1.5m and 0.75m pipes of non-standard lengths also can be supplied on request.

LINE SHAFTS

Line shafts are of high grade carbon steel, ground to close tolerances and threaded concentrically at the ends. Available in nominal lengths of 3.0m, 1.5m and 0.75m and in non-standard lengths to suit specific site conditions. Line shaft in stainless steel and suitable for muff couplings also can be supplied, if required.

LINE SHAFT BEARINGS

Made of bronze for oil lubricated pumps and Nitrile Rubber for water lubricated pumps.

SHAFT ENCLOSING TUBES

(for oil-lubricated pump)

These heavy duty steel tubes protect the line shafts from corrosion and foreign materials and support the line shaft bearings. The tubes are threaded concentrically in one setting at both ends. Available in different lengths, as line shafts.

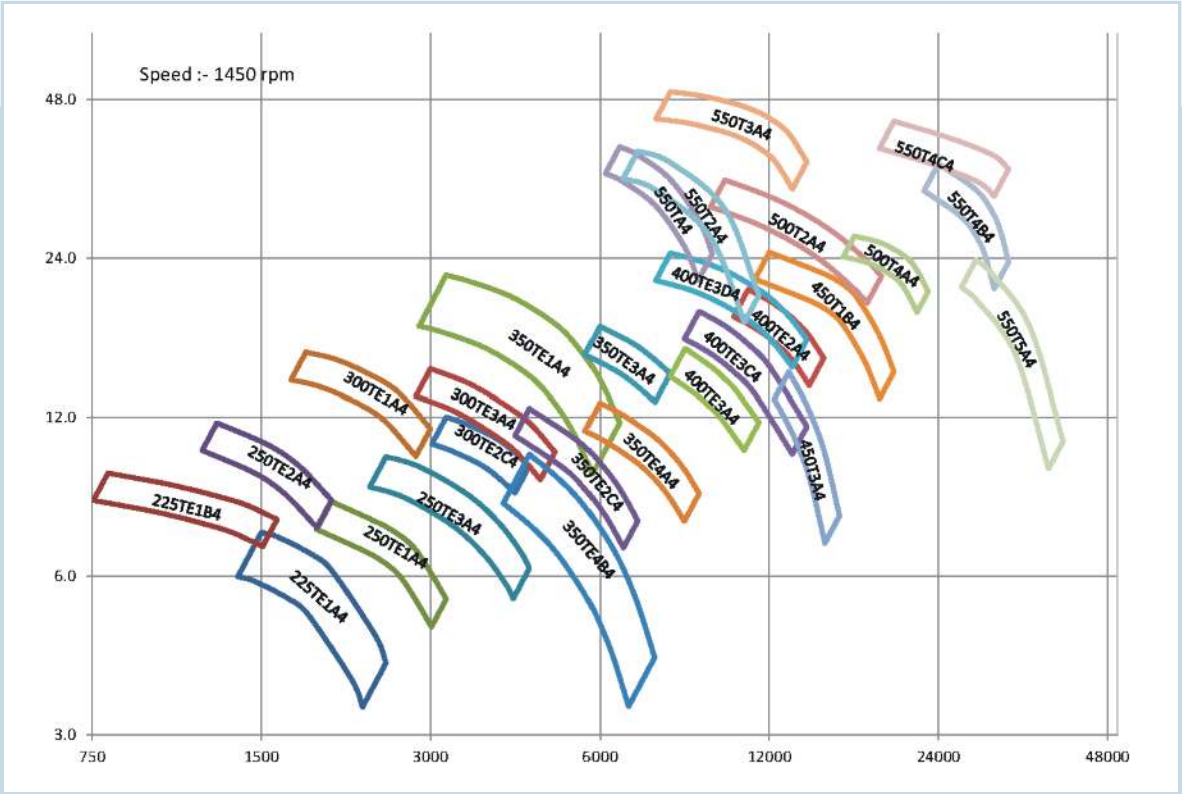
DISCHARGE HEAD

Standard construction in cast iron. Fabricated ones also can be supplied on request. Pump can be supplied with surface or underground discharge to suit specific site conditions.

DRIVES

Electrical motors with vertical hollow shaft or vertical solid shaft are normally used. Alternatively right angle gear head with diesel engine also can be used.

FAMILY CURVE FOR STANDARD VT PUMPS (225 to 550 mm)



STANDARD MATERIAL OF CONSTRUCTION

OIL LUBRICATED / WATER LUBRICATED / FORCE LUBRICATED PUMP

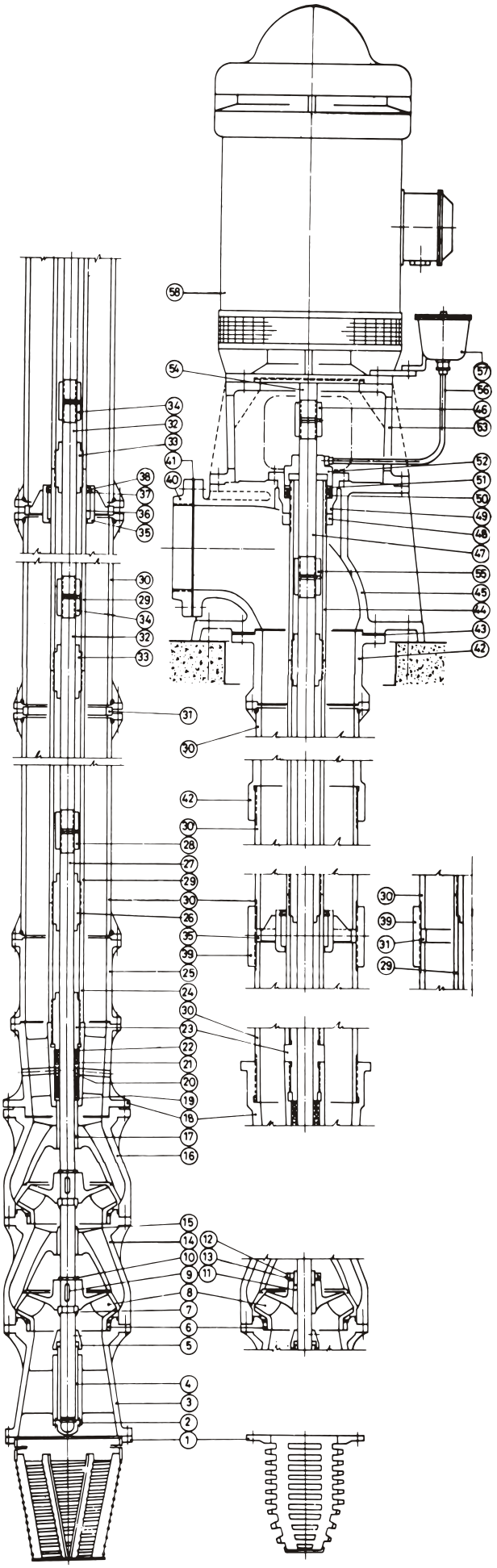
S.NO.	PART DESCRIPTION	MATERIAL	SPECIFICATION
1	STAINER	M.S.	IS : 2062 St.42-S
2	SUCTION CASE	CAST IRON	IS : 210 Gr FG-200
3	SUCTION CASE BEARING	BRONZE	IS : 318 Gr LTB2
4	IMPELLER SEAL RING	CAST IRON	IS : 210 Gr FG-200
		BRONZE	IS : 318 Gr LTB2
5	IMPELLER	CAST IRON	IS : 210 Gr FG-200/260
		BRONZE	IS : 318 Gr LTB2
6	BOWL	CAST	IRON IS : 210 Gr FG-260
7	IMPELLER SHAFT	ST. STEEL	ASTM A276 SS 410
8	DISCHARGE CASE	CAST IRON	IS : 210 Gr FG-200/260
9	COLUMN PIPE ADOPTOR	CAST IRON	IS : 210 Gr FG-200/260
10	GUIDE SPIDER/BEARING HOLDER	CAST IRON	IS : 210 Gr FG-200/260
11	COLUMN PIPE	ERW STEEL	IS : 1239 Class C / IS : 1978
		M.S. FABRICATED	IS : 2062 St.42-S
12	SHAFT ENCLOSING TUBE (OL)	STEEL	IS : 1239 Class C / IS : 1978
13	LINE SHAFT CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
14	LINE SHAFT COUPLING (OL) CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
15	LINE SHAFT COUPLING (WL) ST.	STEEL	ASTM A276 SS 410
16	LINE SHAFT BEARING (OL)	BRONZE	IS : 318 Gr LTB2
17	LINE SHAFT BEARING (WL)	NITRILE RUBBER	SHORE HARDNESS 60-65
18	TOP COLUMN FLANGE	CAST IRON	IS : 210 Gr FG-200/260
19	DISCHARGE HEAD BODY	CAST IRON	IS : 210 Gr FG-200/260
		M.S. FABRICATED	IS : 2062 St.42-S
20	HEAD SHAFT CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
21	STUFFING BOX	CAST IRON	IS : 210 Gr FG-200/260
22	GLAND	CAST IRON	IS : 210 Gr FG-200/260
23	MOTOR SKIRT	CAST IRON	IS : 210 Gr FG-200/260
		M.S. FABRICATED	IS : 2062 St.42-S
24	MOTOR	VERTICAL HOLLOW OR	IS: 325
		SOLID SHAFT	

NOTE : Material of Construction mentioned above are our standard ones, other materials to suit specific site conditions can be supplied on request.

OPTIONAL ACCESSORIES

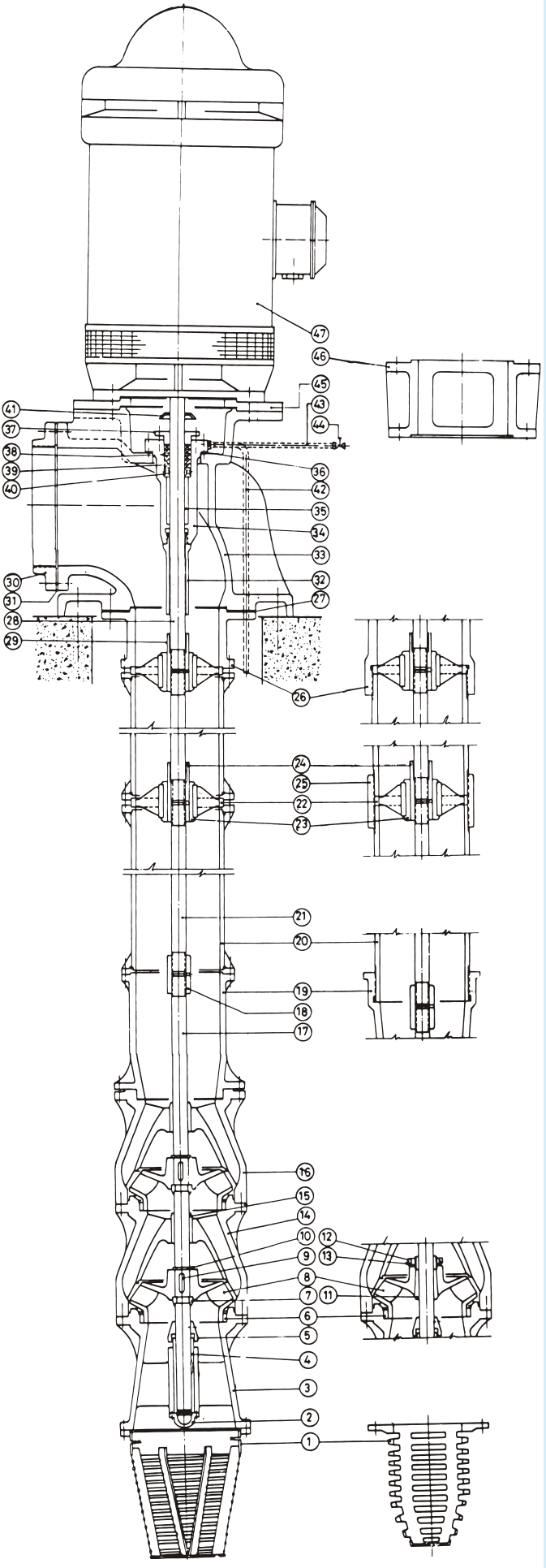
● Foundation bolts ● Sole plate ● Companion flanges.

'JYOTI' VERTICAL TURBINE PUMP
(OIL-LUBRICATED)



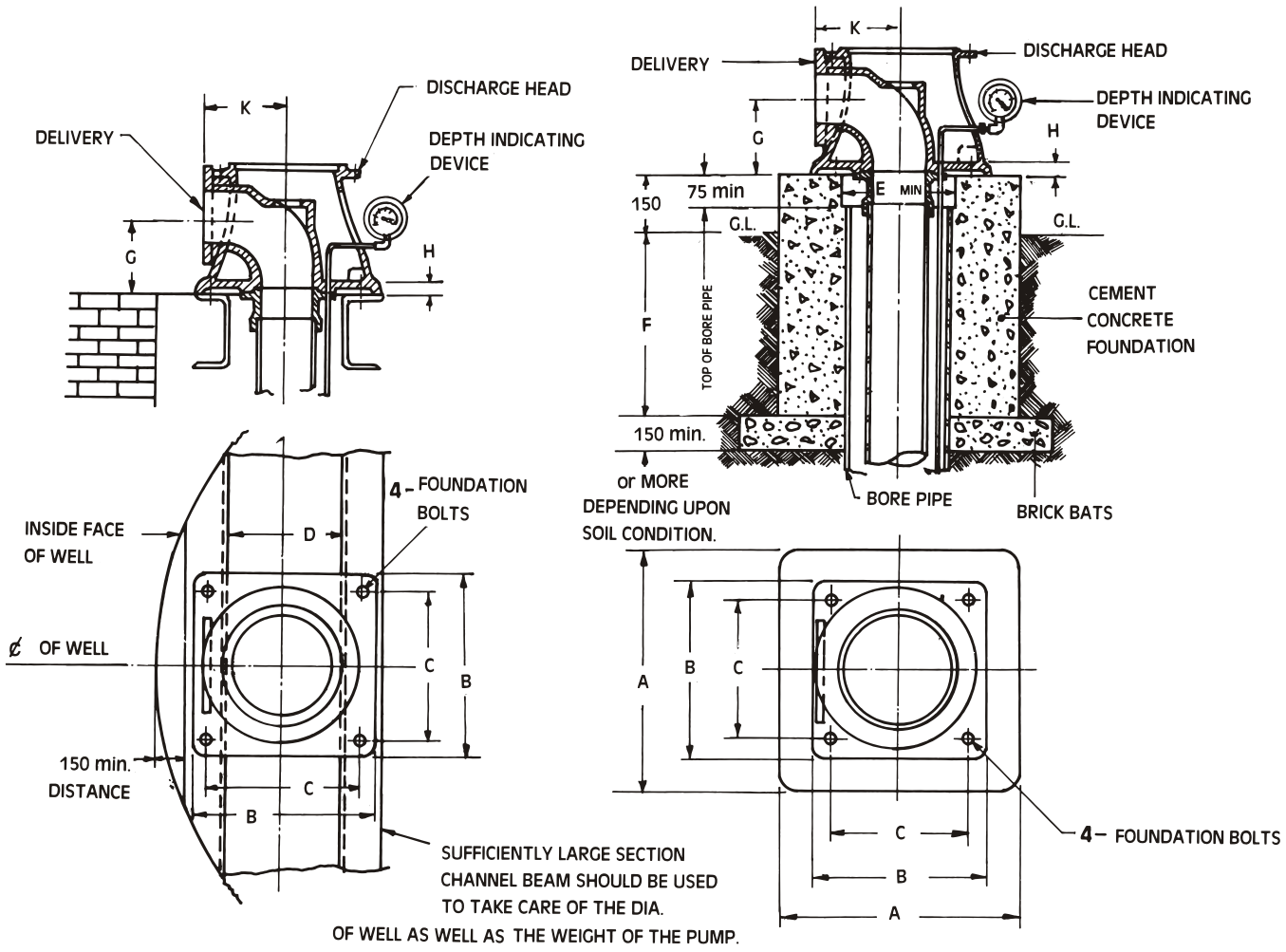
Sr. No.	PART NAME
58	Vertical Hollow Shaft Motor
57	Automatic Lubricator Assly
56	Oiling Pipe
55	Head Shaft Coupling
54	Head Shaft
53	Motor Skirt or Adapting Plate
52	Gland
51	Gland Packing Ring
50	Gland Packing
49	Tube Tension Plate
48	Check Nut
47	Head Shaft Extension
46	Head Shaft Extension Coupling
45	Discharge Head Body
44	Tube Tension Nipple
43	Top Column Flange Gasket
40	Delivery Flange (Up to D-150 Dis-Head)
39	Column Pipe Coupling
38	Circlip
37	Rubber Guide Ring Washer
36	Rubber Guide Ring
35	Guide Spider
34	Line Shaft Coupling
33	Line Shaft Bearing
32	Line Shaft
31	Column pipe spacer
30	Column Pipe Flanged or Threaded
29	Shaft Enclosing Tube
28	Impeller Shaft Coupling
27	Impeller Shaft
26	Impeller Shaft Bearing
25	Column Pipe Adoptor
24	Tubing Adaptor
23	Discharge Case Bearing
22	Impeller Shaft Packing Ring
21	Impeller Shaft Packing
20	Lantern Ring
19	Distance Piece
18	Discharge Case Flange or Threaded
17	Top Bowl Bearing
16	Top Bowl
15	Bowl Bearing
14	Bowl
13	Impeller Collect Nut Washer
12	Impeller Collet Nut
11	Impeller Collet
10	Circlip
9	Impeller Key
8	Impeller
7	Impeller Holding Split Ring
6	Impeller Seal Ring
5	Suction Case Sand Collar
4	Suction Case Bearing
3	Suction Case
2	Suction Case Plug
1	Suction Pipe Strainer

'JYOTI' VERTICAL TURBINE PUMP
(WATER-LUBRICATED)



Sr. No.	PART NAME
46	Vertical Hollow Shaft Motor
45	Adapting Plate or Distance Piece
44	Valve
43	Water Lubricating Tube
42	Water Leakage Tube
41	Water Deflector
40	Lantern Ring
39	Gland Packing
38	Gland Packing Ring
37	Gland
36	Stuffing Box Gasket
35	Stuffing Box Bush
34	Stuffing Box
33	Discharge Head Body
32	Stilling Pipe
31	Delivery Flange Gasket
30	Delivery Flange (Up to D-150 Dis-Head)
29	Head Shaft Coupling
28	Head Shaft
27	Top Column Flange Gasket
26	Top Column Flange - Flanged or Threaded
25	Column Pipe Coupling Threaded
24	Line Shaft Coupling
23	Rubber Bearing
22	Brg. Holder Flanged or Threaded
21	Line Shaft
20	Column Pipe flanged or Threaded
19	Col. Pipe flanged or Threaded or Threaded
18	Impeller Shaft Coupling
17	Impeller Shaft
16	Top Bowl
15	Bowl Bearing
14	Bowl
13	Impeller Collet Nut washer
12	Impeller Collet Nut
11	Impeller Collet
10	Circlip
9	Impeller Key
8	Impeller
7	Impeller Holding Split Ring
6	Impeller Seal Ring
5	Suction Case Sand Collar
4	Suction Case Bearing
3	Suction Case
2	Suction Case Plug
1	Suction pipe Strainer

FOUNDATION DRAWING for 'JYOTI' VERTICAL TURBINE PUMP



PUMP ON OPEN WELL **PUMP ON TUBE WELL**

Discharge Head	A	B	C	D	E	F	G	H	K	L	M	N	Foundation		
													Dia	No.	Length
D/DS 100	600	400	335	260	295	460	156	30	190	4	18	178	M 16	4	250
D/DS 150	640	440	375	295	330	460	203	35	215	8	18	235	M 20	4	300
D/DS 200	775	565	485	410	410	610	235	45	285	8	18	292	M 24	4	500
D/DS 250	900	690	600	500	520	610	270	60	350	8	22	356	M 24	4	500
D/DS 300	900	700	600	500	520	610	320	60	355	12	22	406	M 24	4	500
D/DS 350	1050	850	740	625	590	700	365	60	430	12	24	470	M 24	4	500
D/DS 400	1050	850	740	625	590	700	380	60	430	12	24	521	M 24	4	500

All dimensions are in mm except otherwise stated.

Note : Delivery flanges are acording to BS : 10, Table "E"

Jyoti Ltd. VADODARA (INDIA)
Water • Power • Progress

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